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WAR MACHINE

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A fully illustrated guide to Flamethrowers of World War II

WAR MACHINE

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Flamethrowers of World War 11

The Germans made extensive use of flamethrowers during the battles around the Verdun forts in 1916. Here a Wehrmacht flamethrower team practises for the second round in 1939.

Liquid fire was used in medieval times by the Byzantine navy, but its 20th-century use stems from flamethrowers introduced by Germany during World War I. By World War II such 'terror' weapons were in widespread service, adding new horror to the conflict.

Fire in all its guises has been an established weapon of war since ancient times, but when the flamethrower appeared in its modern form on the battlefields of World War I it seemed that a new aspect of its horrors had arrived. Despite the outcries of disgust that arose on all sides, the flamethrower quickly became an established military weapon and by World War II most armies either had the flamethrower in their armouries or were making active plans to place them there. These early World War II flamethrowers were very different beasts from those that came later in the war, for they were usually not much different from World War I models and in some cases, such as the several improvised designs rushed out in the UK during 1940, virtually identical. Flamethrower tanks had also been developed, although few armoured commanders knew how to use them to best effect when they first encountered them. The potential of the mobile and armoured flamethrower was enormous, as the British Wasp and Crocodile were to demonstrate during 1944 and 1945. Portable flamethrowers had many tactical uses as well, but generally speaking the portable equipments lacked the range and impact of their vehicle-borne counterparts.

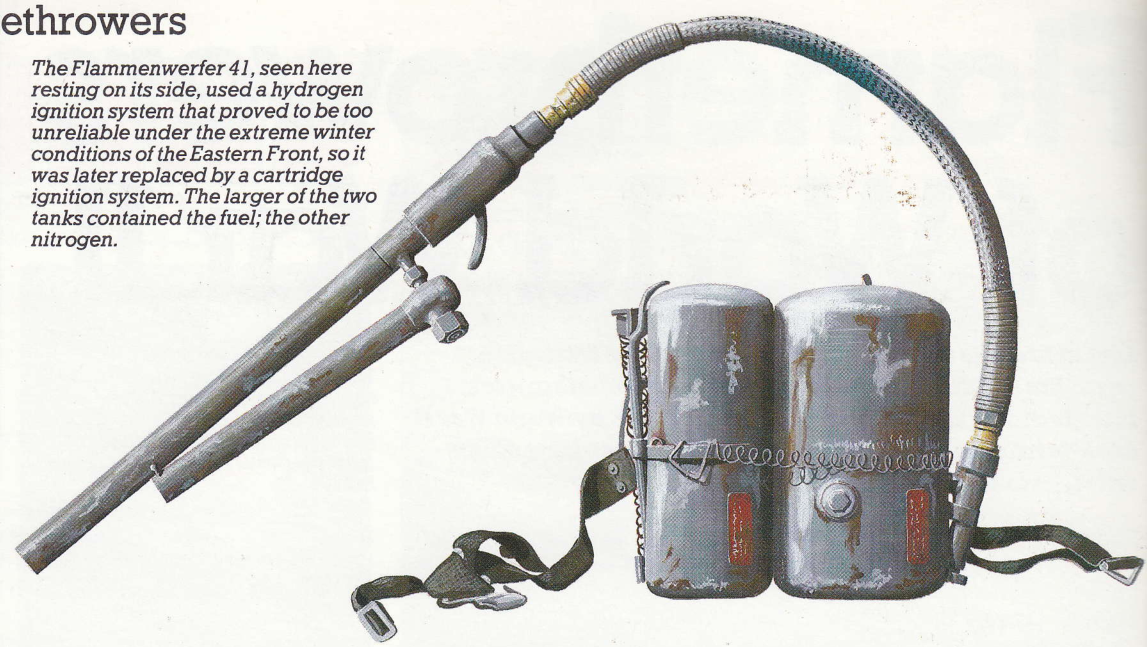
Fire is a dreadful weapon, for not only are its effects dreadful to bear and behold but it has a powerful morale effect. Mankind has an instinctive dread of fire in all its forms, and when it is used offensively in the flamethrower's positive and obvious manner, its impact on an enemy can be considerable. At times during World War II the mere sight of a flamethrower in action was enough to make the enemy break and run, often towards its operators in order to surrender. There are certain types of battlefield target against which the flamethrower can have no effect, but they are not many.

So why are they but little used today? That question is hard to answer, though the main reason seems to lie in the fact that flamethrowers are essentially short-range assault weapons best used in confined areas. Modern warfare is expected to involve mobile forces moving across open country, where flame weapons can be of only little use. This is a nice assumption to make, but it may not be borne out in practice. If urban or close-quarter warfare is ever necessary in future, the flamethrower may well reappear. And if it ever does the contents of this study will provide an indication of what might be expected. Let us hope we never have to encounter them again.

A US Marine uses an M2-2 flamethrower against a Japanese strongpoint on Okinawa. This model was adopted in March 1944 and was first used in action during July 1944 during operations on Guam. The M2-2 was produced in greater numbers than any other American portable flamethrower, and was used mainly in the Pacific theatre.

GERMANY

German flamethrowers



The Flammenwerfer 41, seen here resting on its side, used a hydrogen ignition system that proved to be too unreliable under the extreme winter conditions of the Eastern Front, so it was later replaced by a cartridge ignition system. The larger of the two tanks contained the fuel; the other nitrogen.

The first time the German army used flamethrowers was in 1914, when some were used against the French during the Argonne fighting, but their first large-scale use was against the French (again), this time during the 1916 Verdun campaign. These early flamethrowers were large things that needed up to three men to handle them, but development led to a much lighter version that weighed 'only' 35.8 kg (79 lb). This was the **Flammenwerfer 35**, which was issued to the new German army during the 1930s. In design terms it owed much to the World War I equipment, and it remained in production in 1941.

The Flammenwerfer 35 was gradually supplemented by the **Flammenwerfer klein verbessert 40**, a much lighter 'lifebuoy' model that carried less inflammable fuel, but relatively few of these were produced as they were soon replaced by the **Flammenwerfer 41**, which reverted to the twin-tank arrangement. This remained the standard German flamethrower until 1945, though one important modification was introduced after the grim winter of 1941-2, when the intense cold prevented the normal flame ignition system from working. This system was replaced by a cartridge ignition device that was much more reliable at other temperatures as well. When full this version, which was otherwise identical to the 1941 model, weighed 18.14 kg (40 lb) and the range at best was 32 m (35 yards).

All these German equipments used the twin-tank operating process, one tank containing the inflammable liquid and the other a compressed gas for propulsion. They were all capable of producing multiple bursts but there was one odd model produced for use by parachutists and assault troops. This was a single-shot model known as the **Einstoss Flammenwerfer tragbar** which fired a 1/2-second burst of fire to a range of about 27 m (30 yards). Not many were produced.

It should not be thought that the above were the only German flamethrower equipments, for in this field as in all others the Germans were liable to produce proliferations of models. For instance, in addition to the back-pack Flammenwerfer 35 mentioned above there was also a two-man version known as the **mittlerer Flammnwerfer**, which had its main fuel tank carried on a small trolley. If this were not enough there was also a much larger model carried on a trailer towed behind a light vehicle: this carried enough fuel to produce flame for 24 seconds. Finally, for use in static situations there was a device known as the **Abwehrflammenwerfer 42**, a single-shot device to be buried into the ground with only the flame projector nozzle above ground and pointing towards a target area. This was set off by remote control as an enemy approached, and was the German variation of the old fougasse weapon used for many years in fortifications.

Needless to say, the Germans also made as much use as possible of captured equipments.

Specification

Flammenwerfer 35
Weight: 35.8 kg (79 lb)
Fuel capacity: 11.8 litres (2.6 Imp gal)
Range: 25.6 to 30 m (28 to 33 yards)
Duration of fire: 10 seconds

The fearsome blast of a man-pack flamethrower is seen during a night attack at Stalingrad. Flamethrower operators had to be well protected by friendly infantry as they were vulnerable and highly conspicuous.

A Flammenwerfer 35 is seen in action against a concrete emplacement in Poland after the 1939 campaign. The Flammenwerfer 35 had a range of 25.6 to 30 m (28 to 33 yards) and carried enough fuel for 10 seconds of use, but it weighed 35.8 kg (79 lb) and so was often carried into action by two men.

A German assault pioneer team is seen with one member of the team carrying the weight and bulk of a Flammenwerfer 35. This equipment weighed 35.8 kg and was an awkward load for one man to carry, but the equipment remained in production until 1941. Its basic design dated from 1918.

GERMANY

German flamethrower tanks

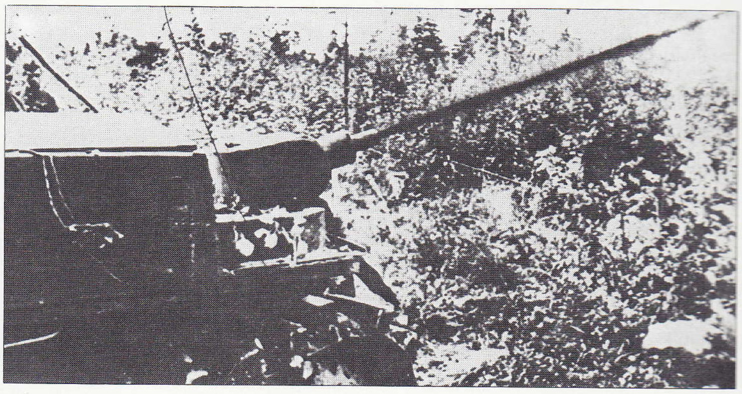
Throughout World War II the Germans were not particularly energetic in the deployment of flamethrower tanks, even though they were fielding a light flamethrower tank at a time when no other nation was doing so. This was in 1941 when, following a period of trials, a PzKpfw I was converted to take a Flammenpanzer 40 flame projector in place of one of the machine-guns in the turret. This produced the **Flammpanzer I**, and the first of them were used in action by the Deutsches Afrika Korps in North Africa. This expedient was soon followed by another, this time the **Flammpanzer II** which was a conversion of the otherwise little-used PzKpfw II Ausf D or E. On this conversion two flame projectors were used, one on each side of the front hull. Each projector had a range of about 36.5 m (40 yards). Not many of these conversions were made, and most appear to have been used on the Eastern Front.

The most numerous conversions to the Flammpanzer role were made with the PzKpfw III Ausf H or M. At least 100 of these tanks were converted to take a flame projector in place of the main gun, and there was capacity internally for 1000 litres (220 Imp gal) of fuel. These **Flammpanzer III** vehicles were very effective but do not appear to have been much used, mainly as a result of their inability to defend themselves against enemy tanks, for whenever they were used in action other 'gun' tanks had to be used to guard them.

Apart from the odd trials model, no PzKpfw IV was converted to the operational Flammpanzer role. Apparently there were plans to convert various marks of Panther and Tiger II to the flame role, but none appear to have seen fruition. Instead the little **Flammpanzer 38(t)** was placed into production during 1944 as the standard flame tank of the land forces. This small tank was well suited to the role as it used the low and easily concealed hull of the Hetzer tank destroyer. Once again the flame gun took the place of the main gun and some of the internal space was devoted to fuel for the projector.

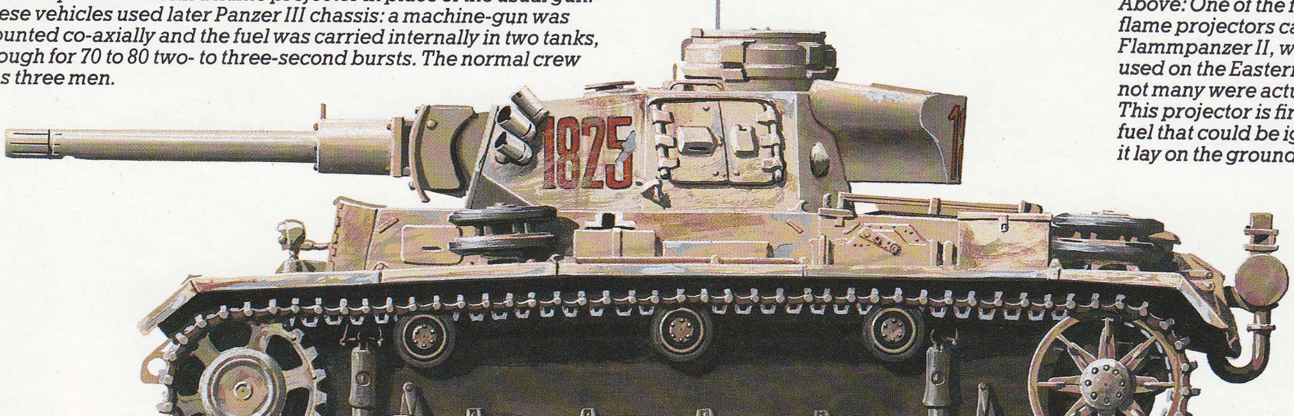
A few captured tanks were used by the Germans for the flame role. One example was the large Char B, one of the French tanks captured by the Germans in 1940, but once again the number involved was not great, probably about 10.

For much of the war the German army relied upon the SdKfz 251 half-track for the flamethrowing role. The version used was the **SDKfz 251/16 mittlerer Flammpanzerwagen**, first used during 1942. This carried two fuel tanks, each containing 700 litres (154 Imp gal) of fuel, enough for 80 two-second bursts of flame. Each fuel tank supplied its own projector, one each side of the open vehicle rear; some had a third but smaller projector at the front, but on most vehicles this position was occupied by a machine-gun. The usual range of these projectors was about 35 m (38 yards).



Above: One of the forward-mounted flame projectors carried by the Flammpanzer II, which were mainly used on the Eastern Front although not many were actually produced. This projector is firing a rod of unlit fuel that could be ignited later when it lay on the ground.

A Flammpanzer III with a flame projector in place of the usual gun. These vehicles used later Panzer III chassis: a machine-gun was mounted co-axially and the fuel was carried internally in two tanks, enough for 70 to 80 two- to three-second bursts. The normal crew was three men.



Flame Technology

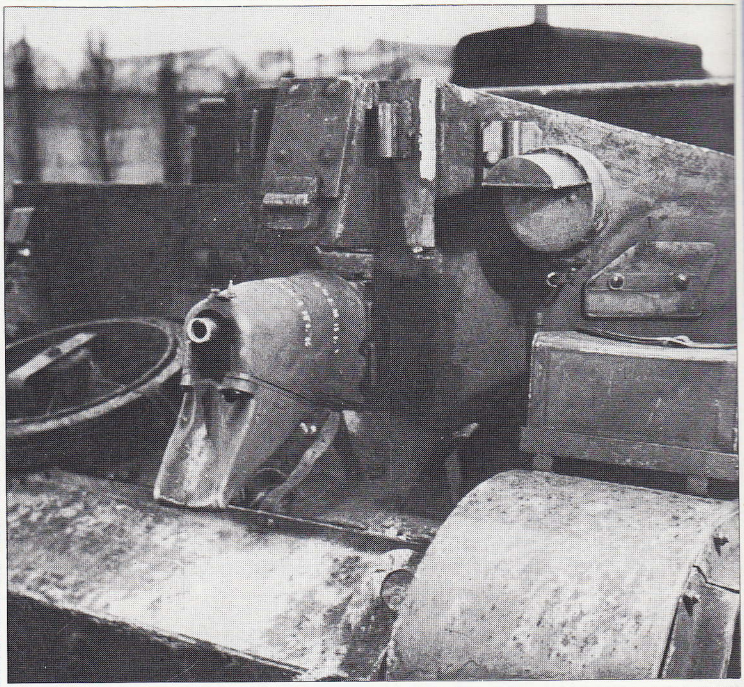
Flamethrowers might have appeared to be brutally simple weapons, but in fact they presented a host of complex design problems; fuel composition, propellant gas and ignition systems all underwent considerable development during the war. Fortunately for the Allies, it was their scientists who produced the better models.

Any flamethrower, static, man-portable or vehicle-borne, has four main components. They are the fuel, the fuel system, the pressure system and the projector and ignition system. With so few components to worry about, it is not too surprising that all the flamethrower weapons in use during World War II had many factors in common and many even looked alike.

However, there was one area in which Axis and Allied flamethrowers differed considerably, and that was in the type of fuel that produced the flame. When the war started both sides were using what were basically the same fuels, those of World War I. There were several of these, but typical was that used by the Germans, which was of the petrol/tar-oil variety. Generally speaking this fuel was rather thin in quality and it had the tactically unfortunate property of burning up almost as soon as it left the projector nozzle. Thus although the flame produced could be very spectacular its effects on target were often slight and transient. Ranges were also short. The only way to improve the performance of the flame jet was to thicken the viscosity of the fuel. If this could be done the resultant flame jet would form what was known as a 'rod' which could travel much further to carry its burning properties with it. Research demonstrated the abilities of these thick flame rods to smack against a target and so add to the final effects.

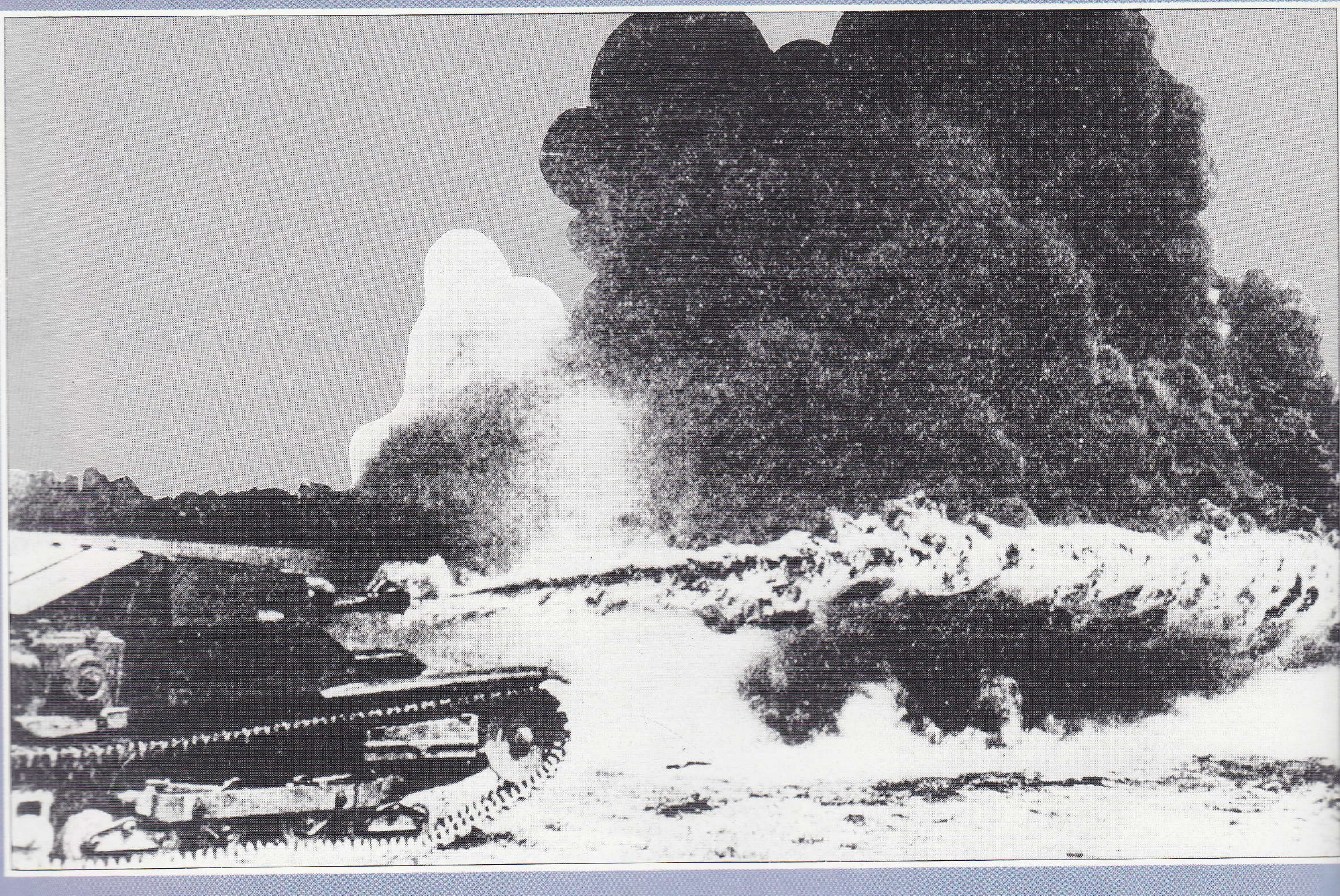
Fuel thickening

The problem was how to thicken the fuel. At first all manner of substances were tried, including such obvious agents as rubber, thick tars and creosote, but these made little difference. The breakthrough came when it was discovered that a group of chemicals known as aluminium 'soaps' added to petrol would provide all the properties required. These 'soaps' had virtually nothing in common with the familiar washing substances; the type most commonly used to thicken petrol was an agent known as aluminium stearate. Although difficult to manufacture in quantity to the required quality this agent, when added to petrol, thickened a flamethrower jet to such an extent that when it struck a target it would break up into small blobs of burning fuel that could scatter over a wide area. By varying the mount of the agent added, thickened fuels of varying weight and viscosity could be produced to suit various types of flamethrower.



Above: The flame projector of the Wasp Mk II was situated in the front hull in place of the usual Bren machine-gun. It could be elevated and traversed to a limited degree, and was so small that it was usually impossible to spot as a flamethrower until it was used in action.

Below: An L3 Lanciafiamme demonstrates its abilities. On these small and light vehicles the flame was more often a morale weapon rather than a practical one, due mainly to the light armour on the vehicle, although it was dreadfully effective against native troops in Ethiopia.



Fortunately only the Allies made this discovery. Throughout the war the Germans, Japanese and Italians had to continue to use their old petrol/tar-oil mixtures with all their short range and other disadvantages, while the Allies, including the Soviets, could produce weapons with much longer ranges and other useful properties such as the ability to produce flame rods that could bounce around the interiors of structures to reach areas out of the direct line of fire.

Coupled with the fuel were the fuel systems. In the main these simply consisted of a tank or tanks with the necessary valves and hoses to connect them to the flame projector. The flame projector itself was usually a very simple pipe along which the fuel was propelled to the ignition system at the muzzle of the projector. The pressure system was responsible for this propulsion, and consisted usually of a compressed gas contained within one or more pressure cylinders and released at a fixed rate for the propulsion process. Attempts were made to use pumping systems in place of compression systems, but none of them worked, especially with thickened fuels, as the pumping action usually broke up the fuel structure and destroyed its rod properties. Thus the compressed gas systems were used almost universally, the exceptions being a few odd cases (such as the improvized British Home Guard models) and some tank flamethrowers.

Propulsion systems

The gases varied, compressed air being used on some models as it was easy and cheap to produce, but it had the disadvantage of burning when it came into contact with fuel. Thus various inert gases were favoured, among them carbon dioxide, nitrogen or an inert gas formed by burning off oxygen from the air; if required this last could be produced out in the field using special apparatus. Hydrogen was another alternative, for although it is inflammable it could be used for the ignition system as well. As the war ended the Allies were carrying out experiments with slow-burning cordite to create working pressure, but other combustible powders were also under investigation. The war ended before these experiments came to anything, and the compressed gas systems remained in use for all but 'single-shot' flamethrowers.

Compressed gases

As it turned out, different types of weapon used varying types of pressurizing gas. The Crocodile used nitrogen or inert gas and the Wasp used carbon dioxide. The Lifebuoy used hydrogen, while the Italian flamethrowers usually used nitrogen. The Japanese chose to use compressed air. On the Allied side it was never decided whether these gases should be delivered as a form of ammunition or made in the field, and in the end both procedures were used.

The ignition system was all too often the weakest point in the design of any flamethrower. As the fuel gushed from the projector muzzle it had to be ignited in some way, and throughout World War II mainly unsatisfactory methods were used. The earliest methods were crude to an extreme. Most World War I flamethrowers had usually had a wad of something like cotton waste impregnated with paraffin held close to the projector muzzle and at least one World War II design, the Harvey, used exactly this method. However, most World War II designs were more advanced. The usual one was to place a small electrical coil in the path of a flammable gas or liquid to produce an ignition 'hot spot'. The flammable substance was usually petrol or a gas such as hydrogen emitted into the ignition system for as long as the burst was required. The weakness here was normally the electrical source, usually a small torch-sized battery that all too often failed under damp or cold conditions, leaving a flamethrower operator in a parlous situation. On the large vehicle-borne equipments more positive electrical systems using higher voltages and flammable liquid such as petrol could be used with far less uncertainty, but the portable equipments had to look for something better, usually in the form of a blank cartridge that produced a large number of hot sparks when detonated by a percussion mechanism, and by the time the war ended there were various types of spark-producers. One used on the US M2-2 portable flamethrower had a revolver chamber to hold the cartridges and index to the next cartridge for each burst. Using this device up to six virtually certain flame jets could be produced before more cartridges had to be inserted.

Terror weapon

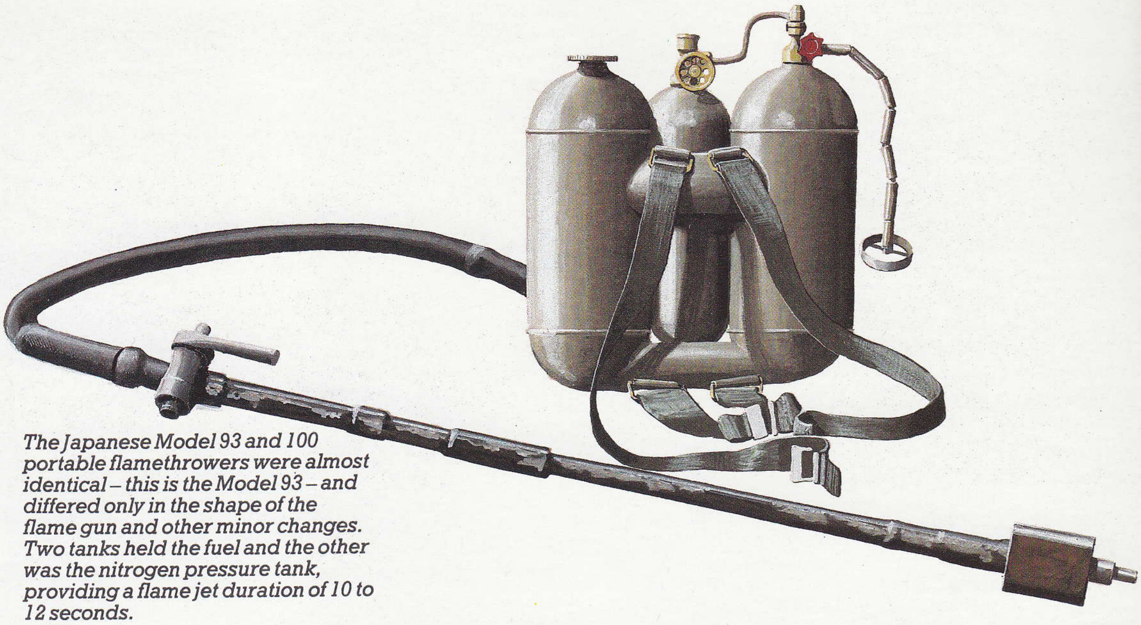
So much for the mechanics of the flamethrower, but a few words on tactics are also in order. Flamethrowers are essentially assault weapons, and like most weapons of this nature they are close-range devices, more akin to the rifle and machine-gun than any others. They are at their best when used en masse, and when large-scale use can be augmented with surprise their effects can be greatly magnified. They cannot produce results on their own. As with every other type of weapon they require support and co-operation from other arms and they require infantry to follow up their results. They also require careful reconnaissance, for not every target is suitable for their fiery output, and even those that are suitable must be approached in a safe and appropriate manner.

Perhaps the greatest effect of the flamethrower is not on material but on morale. All mankind has an instinctive dread of fire, and when the flamethrower is used as a long-range probing weapon (as was often the case in World War II) any soldier will immediately dread the results. Time and time again during World War II the mere sight of a flame burst was enough to make the toughest and best-trained soldiers turn and run.

A US Army flamethrower team is shown on Bougainville, April 1944. The rifleman is supposed to spot enemy snipers before they shoot the operator. The discovery that aluminium stearate could increase the viscosity of the fuel ensured that Allied flamethrowers were longer-ranged and more lethal than their Axis equivalents.

JAPAN

Portable Flamethrower Types 93 and 100



The Japanese Model 93 and 100 portable flamethrowers were almost identical – this is the Model 93 – and differed only in the shape of the flame gun and other minor changes. Two tanks held the fuel and the other was the nitrogen pressure tank, providing a flame jet duration of 10 to 12 seconds.

If war-time propaganda photographs are to be believed, the Japanese army and marines made extensive use of flamethrowers during World War II. This impression came largely from a long series of 'official' photographs taken during Japan's protracted war against the Chinese, where weapons such as flamethrowers could have a morale effect that far outweighed their usefulness as combat weapons. Against the flimsy structures used as housing throughout mainland China flame weapons could gain impressive results, and accordingly the Japanese made much use of them.

At first the main version used by the Japanese was the **Portable Flamethrower Type 93**. This was first issued during 1933 and was an orthodox design that made much use of German experience in World War I. It used three cylinders on a rather awkward back-pack arrangement, two of the cylinders containing the fuel and the central (and smaller) cylinder containing the compressed gas. When the Type 93 was first issued this was compressed nitrogen, but this was soon changed to compressed air. From 1939 onwards a small petrol-driven air compressor was issued with each equipment. This was the Type 99 compressor and when not in use it was transported in a small wooden case.

For various reasons the flame projector of the Type 93 was considered to be unsatisfactory, and in 1940 it was changed to a new type. This was known as the **Portable Flamethrower Type 100**, but in every other aspect it was identical to the Type 93. The new flame gun was shorter than the earlier model – 901 mm (35.5 in) as opposed to 1.197 m (47.125 in). The nozzle of the flame gun could also be easily changed on the Type 100, whereas on the Type 93 it was fixed.

Although the Japanese infantry made use of flamethrowers, the Japanese tank formations made only limited use of the weapon. Apparently only one attempt was made to produce flamethrower tanks and this was a small unit of specialized combat enineering tanks that were encountered on Luzon in 1944. These turretless tanks were fitted with obstacle-clearing equipment on the front hull and mounted a single flamethrower forward. Both internal and external fuel tanks were carried. The tank used as the basis appear to have been the Type 98 medium, whose only other armament was a single machine-gun.

Specification

Portable Flamethrower Type 100

Weight: 25 kg (55 lb)

Fuel capacity: 14.77 litres (3.25 Imp gal)

Range: about 22.9 to 27.4 m (25 to 30 yards)

Duration of fire: 10 to 12 seconds

USA

Portable Flame-Thrower M1 and M1A1

The American M1 flamethrower was a development of the earlier E1R1 which, although technically an experimental model, was used in action in 1943. The M1 was used for the first time during the Guadalcanal campaign of June 1942, and used the old 'thin' type of fuel.

When the US Army requested a new portable flamethrower in July 1940, the Chemical Warfare Service had absolutely no knowledge base upon which to work, and so had to start from scratch. Using a model known as the **Flame-Thrower E1**, gradual development reached the stage where the **E1R1** was ready for troop trials, some of which were carried out under combat conditions in Papua. The E1R1 was far from perfect for it was easily broken and the controls were difficult to reach, but a more rugged version was accepted for service as the **Portable Flame-Thrower M1**. This M1 was much like the E1R1 in that it had two tanks, one for fuel and the other for compressed hydrogen.

The M1 went into production in March 1942, and the weapon was in action during the Guadacanal operations of January 1943. It proved to be something of a disappointment, for the M1 was prone to all manner of production faults, and these often meant that the weapon failed in action. The ignition circuit used electrical power supplied by batteries that often failed under active service conditions, and the tanks were liable to pin-hole corrosion spots that allowed pressure to escape. A special repair and inspection service had to be established to ensure a serviceable reservoir of M1s ready for action.

By June 1943 a new model was in use. This was the **M1A1**, of which 14,000 examples were produced. The M1A1 was an M1 modified to make use of the new thicker fuels produced by placing additives in the petrol-based fuels previously employed. This thicker fuel gave better flame effects and a range of up to 45.7 m (50 yards) compared with the maximum of 27.4 m (30 yards) of the M1. Unfortunately the troublesome ignition system was not altered in any way and the previous problems persisted to the point where troops in action sometimes had to ignite the flame jets with matches or pieces of burning paper.

M1A1s were used in Italy and the Far East; their use in Europe after June 1944 appears to have been somewhat restricted once the Normandy campaign was over.

Specification

Portable Flame-Thrower M1A1

Weight: 31.8 kg (70 lb)

Fuel capacity: 18.2 litres (4 Imp gal)

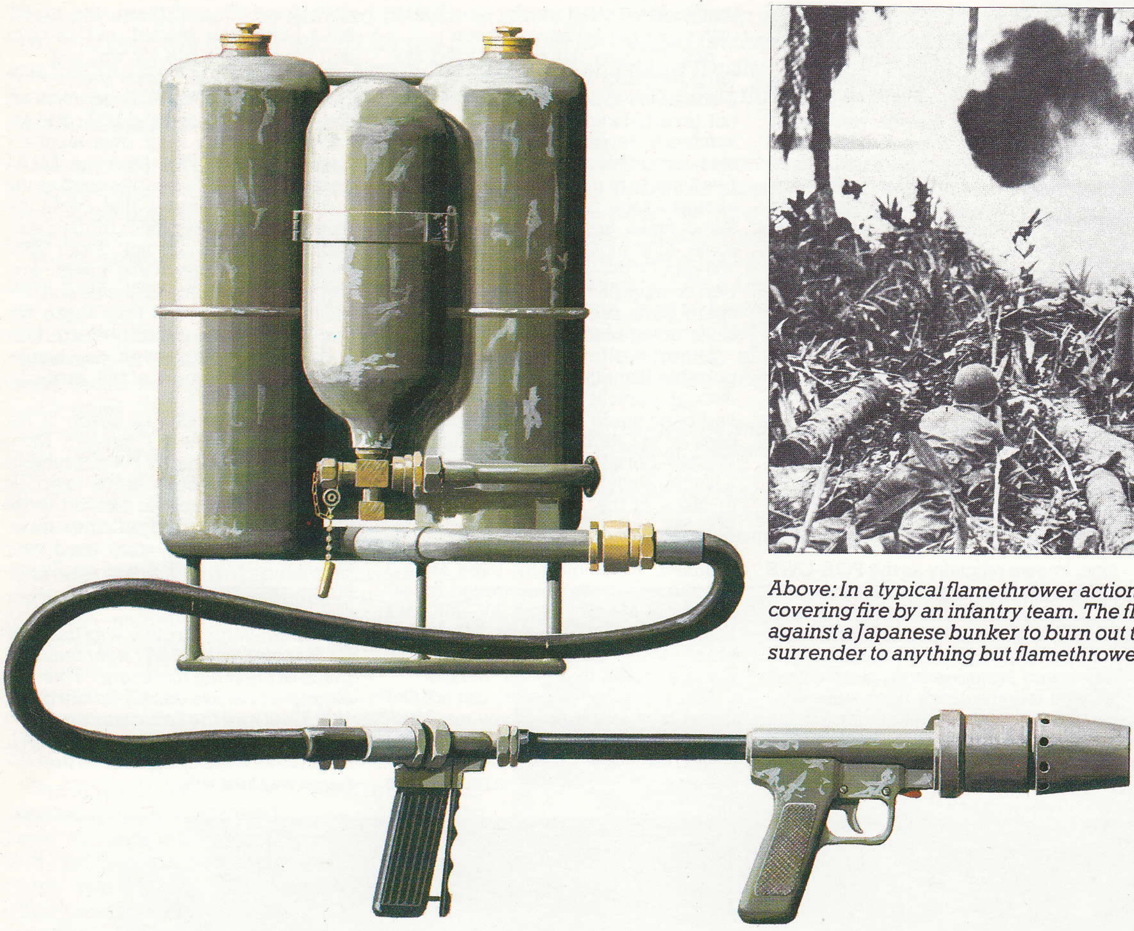
Range: 41 to 45.7 m (45 to 50 yards)

Duration of fire: 8 to 10 seconds

USA

Portable Flame-Thrower M2-2

Above: In a typical flamethrower action the flame gun operator is given covering fire by an infantry team. The flame weapon is an M2-2, being used against a Japanese bunker to burn out the occupants, who were usually loth to surrender to anything but flamethrowers – and often not even then.



Left: The Portable Flame-Thrower M2-2 was produced by the Americans in greater numbers than any other type, and was first used on Guam in July 1944. It was to remain the standard American flame weapon for many years after 1945 and saw action in Korea. Its maximum range under good conditions was 36.5 m (40 yards).

By mid-1943 the Chemical Warfare Service had a much better idea of what kind of portable flamethrower the troops required and set about designing a new type. Based on an experimental design known as the **E3**, the **Portable Flame-Thrower M2-2** was evolved, and this featured several improvements over the old M1A1. The M2-2 continued to use the new thickened fuel but it was a much more rugged weapon carried on a back-pack frame (very similar to that used to carry ammunition) but the main improvement was to the ignition. This was changed to a new cartridge system using a revolver-type mechanism that allowed up to six flame jet shots before new cartridges had to be inserted. It proved to be much more reliable than the old electrical methods.

The M2-2 was first used in action on Guam in July 1944 and by the time the war ended almost 25,000 had been produced, more than the totals of M1s and M1A1s combined. However, production was not easy and some troops in the Pacific theatre continued to use the old M1A1 until the war ended. It was March 1945 before the first M2-2s arrived in Italy.

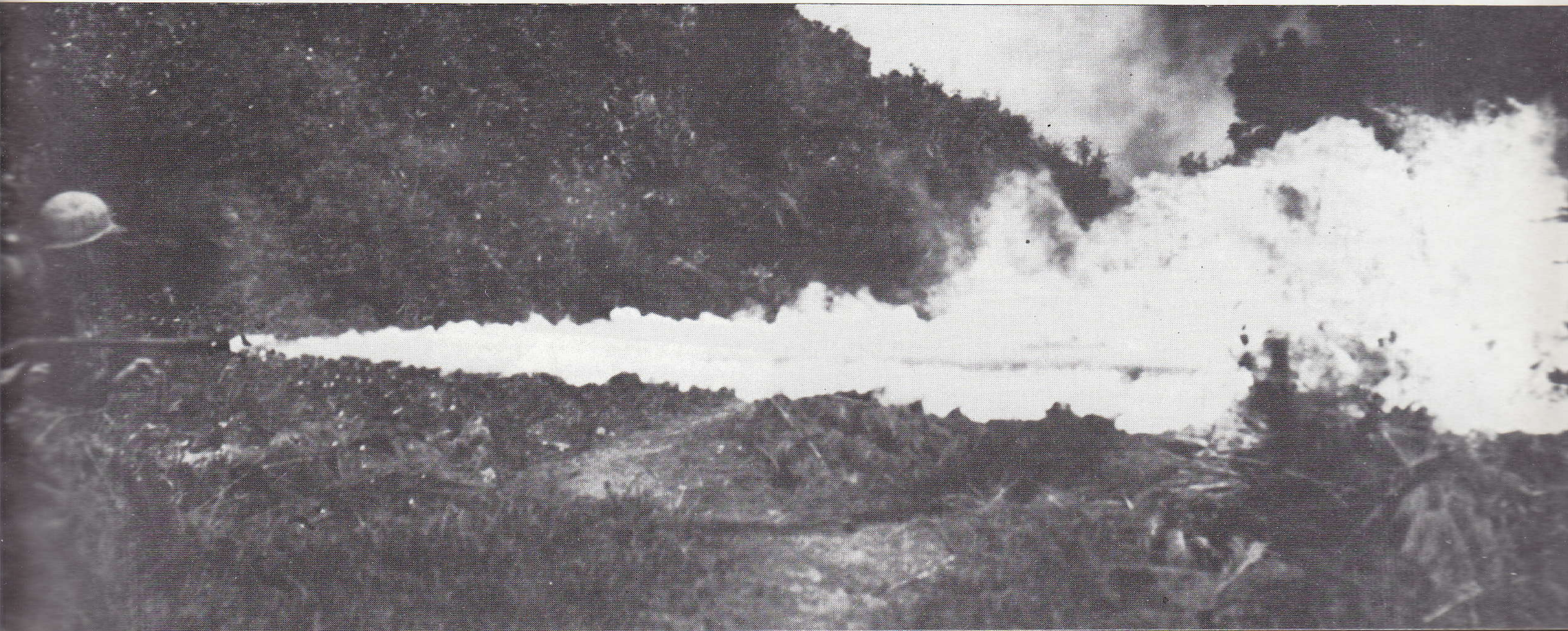
M2-2s were used by armies other than that of the Americans. Some were passed to the Australian army, bringing to a halt the development of an indigenous Australian flamethrower known as the Ferret.

Although the M2-2 was an improvement over the M1 and M1A1, the US Army still considered that it was not what was really wanted, and development continued to find a better and lighter weapon. Some work was carried out to evolve a single-shot flamethrower that could be discarded after use. A model that used a combustible powder to produce pressure to eject 9 litres (2 Imp gal) of thickened petrol-based fuel from a cylinder was under development as the war ended, but the project was terminated soon afterwards. It would have had a range of 27.4 m (30 yards).

Specification

Portable Flame-Thrower M2-2
Weight: 28.1 to 32.7 kg (62 to 72 lb)
Fuel capacity: 18.2 litres (4 Imp gal)
Range: 22.9 to 36.5 m (25 to 40 yards)
Duration of fire: 8 to 9 seconds

In addition to their noise, flamethrowers had a powerful visual effect on morale, and the mere sight of their flame jet was often enough to make even the strongest men quail. This is an American M2-2 in action on Ie Shima in June 1945.



American tank flamethrowers

The first American tank flamethrower was produced in 1940, and this **Flame Projector E2** mounted in an M2 medium tank was demonstrated to US Army tank officers in mid-1940. They were not impressed and the project was allowed to lapse. It was not long before opinions changed, but by that time the Chemical Warfare Service designers had to start once again from the beginning and before long had a pump-operated **Flame Projector E3** mounted in the turret of an M3 Lee medium tank. The pump system tended to break up the fuel structure and so reduce flame performance and range, but when the pump was replaced by a compressed air system these drawbacks were eliminated.

At the same time as these experiments were under way, another programme to produce a service weapon rapidly was initiated under the **'Q'** (Quickie) designation. The British/Canadian Ronson flame system was obtained from Canada, but initial trials had to be conducted with the system mounted on the rear of a truck as no tanks were available. The 'Q' project continued until an installation to be fitted to the turret of the M5A1 light tank was developed, but the tanks into which this system was supposed to be installed were simply not forthcoming and the 'Q' project thus turned out to be anything but a quickie. In fact it was early 1945 before any of the 'Q' systems, by then known as the **M5-4**, were ready for service in the Far East. Four were used in the Philippines.

While all this development work was being conducted in the continental USA, troops in Hawaii were busy producing actual weapons. Using the Ronson flame projector as their basis, they mounted flame systems in place of the old turret guns on obsolete M3A1 light tanks which were renamed **Satan**. Once installed these Satan systems used compressed carbon dioxide as the propellant gas, and could fire thickened fuel to a range of 73 m (80 yards); each vehicle could carry 773 litres (170 Imp gal) of fuel. The initial 'production run' was for 24 Satans, and by June 1944 they were in action on Saipan.

The success of the Satan in action prompted commanders to request a similar installation in the M4 medium tank. Old 75-mm (2.95-in) tank gun barrels were used to mount the Ronson flame projectors and this new tank version, known officially as the **POA-CWS '75' H-1** (H denoting Hawaii), was used in action during the Ryukyus operation. The type was later used on Okinawa, in a special application to flame out defending Japanese from deep caves: several lengths of fire hose were connected together and taken deep in the caves, one end then being connected to the M4 flamethrower tank which pumped fuel along the hose to be ignited at the other end by an operator using a portable flamethrower.

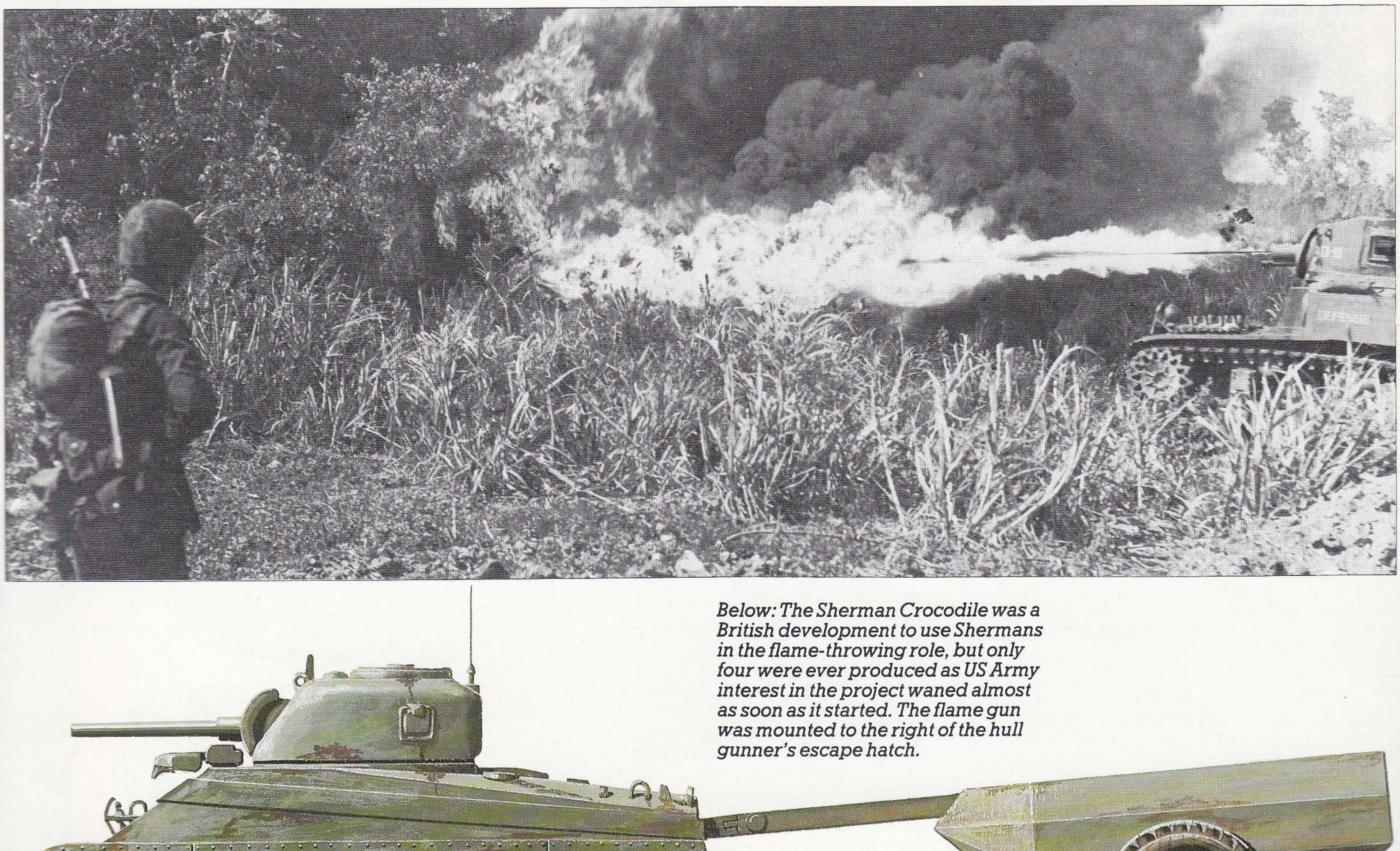
Both of these flame-producing systems mounted the flame projector in place of the main armament, a feature not greatly liked by the 'tankies', who wanted to retain some form of defensive armament. Attempts had already been made to mount a flame projector alongside the main gun on some M4 flame tanks and in the latter stages some M4s mounting 75-mm guns or 105-mm (4.134-in) howitzers also carried co-axial flamethrowers, but lack of spare parts prevented many conversions being made.

Other earlier attempts to mount portable flamethrowers that could fire through ports at the front of light tanks had been made but without much success, so in October 1943 the Chemical Warfare Service was asked to produce a flamethrower that could be mounted in place of the bow machine-gun on M3, M4 and M5 tanks, so that if required the machine-gun could be re-installed. Consequently 1,784 **M3-4-3** flamethrowers were produced for installing in M4 tanks and 300 **E5R2-M3** flamethrowers for use on M3 or M5 tanks. Many of these were used in Europe and in the Pacific theatre.

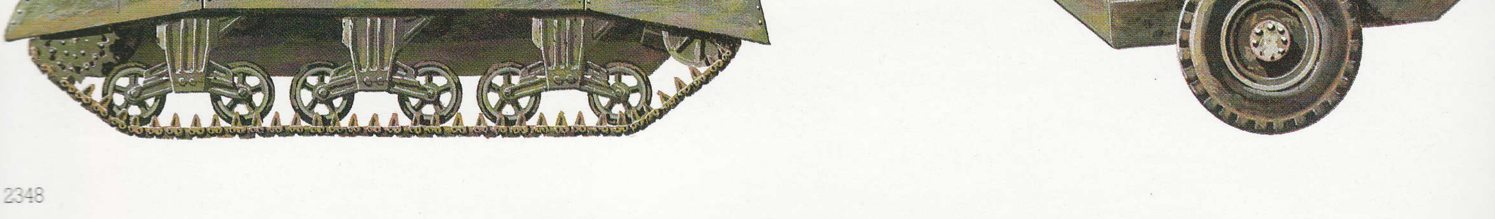
Many tank commanders did not like the idea of losing their bow machine-guns, so an alternative installation that could be mounted next to the commander's periscope on the turret top was developed. One of these, the model **M3-4-E6R3**, was placed into production but was too late for war use.

Once again the troops stationed in Hawaii did not wait for weapons to arrive from the continental USA, and set about producing their own auxiliary flamethrowers. This time the M1A1 portable flamethrower was used as the basis for a projector that could be mounted in place of the bow machine-gun of an M4 medium tank. Some 176 of these conversions were made, and were on hand for the Okinawa and Iwo Jima campaigns, but they were not much used as the troops preferred the 'local' conversions with the turret-mounted systems on M4 medium tanks.

Mention must also be made of the installation of the 'Q' project M5-4 flamethrower in the LVT-4 amphibious carrier. Six of these were used on Peleliu, but the carrier proved to be rather unsatisfactory for flame operations. Although they were used very effectively, the LVT-4 was really too lightly armoured.



The Satan flamethrower was used on US Marine Corps M3A1 light tanks in place of the main turret gun. This example is in use on Saipan during July 1944, and the Satan was so successful that many more old M3A1 light tanks were converted to the flame warfare role.



Below: The Sherman Crocodile was a British development to use Shermans in the flame-throwing role, but only four were ever produced as US Army interest in the project waned almost as soon as it started. The flame gun was mounted to the right of the hull gunner's escape hatch.

The Fall of Iwo Jima

The capture of Iwo Jima fulfilled two American objectives: firstly, it enabled the Air Force to provide fighter escort for the B-29 Superfortresses on their bombing raids against mainland Japan; and, secondly, the fall of an island traditionally part of the Home Islands might at last bring Japan's leaders to realize that the days of their Pacific Empire were numbered.

By the end of 1944 it had become quite evident to the US commanders in the Pacific that in the near future they would have to mount a large-scale attack on the Japanese island of Iwo Jima.

Three factors made the decision inescapable. First, heavy Boeing B-29 bomber raids on the Japanese mainland, then being mounted from the Marianas, were proving prohibitively expensive as even North American P-51 Mustangs could not escort them on the 4505-km (2,800-mile) round trip, and they thus lacked essential fighter protection over the target area; Iwo Jima lies only 1060 km (660 miles) from Tokyo and possessed two airfields, one of which could take B-29s immediately. Second, even with no further advance towards Japan Iwo Jima was a highly desirable link in the defences of the newly-captured Marianas. And thirdly, the island was traditionally a part of the Japanese homeland (it was administered by the Tokyo prefecture), and its fall would thus constitute a severe psychological blow to the Japanese people. The island must therefore be captured; isolation would not be enough.

Strategic importance

Unfortunately for the Americans, the Japanese high command possessed just as keen an understanding of strategic realities, and had long appreciated the necessity of denying Iwo Jima to the Americans. One staff officer even went so far as to suggest that as Japanese air and naval strength had suffered an apparently irreversible erosion, serious consideration should be given to a project of sinking the island into the Pacific, or if not the whole island then at least the half which contained the main airfield. Iwo Jima is, after all, only 8 km (5 miles) long averaging 4 km (2.5 miles) wide, and at its tallest point (the summit of Mount Suribachi) only 168 m (550 ft) high.

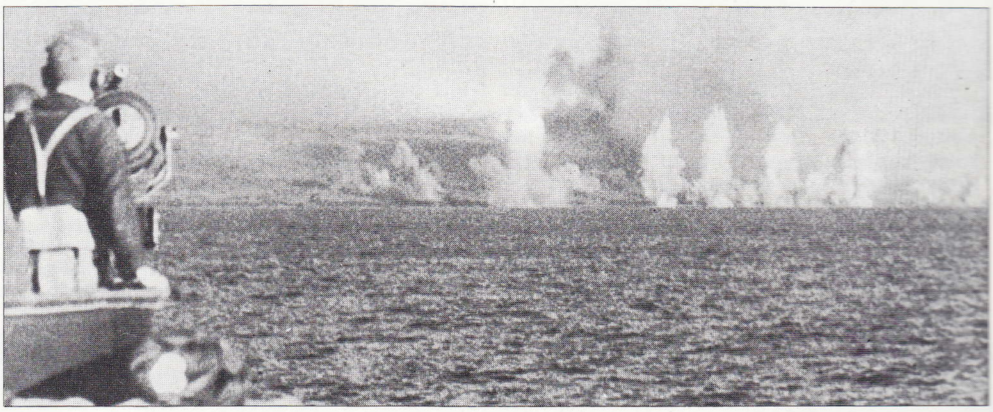
The suggestion was turned down, but as early as June 1944 the highly regarded General Kuribayashi was sent to organize the defence of the island, and given clearly to understand that in case of failure he should not expect to see his family or homeland again; the same stricture applied to the 14,000 veteran troops who followed him to Iwo Jima during the months which followed. As they were provided with heavy and medium artillery, anti-aircraft batteries, heavy and light machine-guns, mortars and tanks, together with relevant ammunition all on an ample scale, their morale was in no way cast down by their predicament.

Bunkers and tunnels

They therefore set to work with a will, dug their artillery well into the ground, and constructed successive lines of defence across the width of the island (linking many of their strongholds with underground tunnels), a task in which they were considerably aided by the fact that Iwo Jima is of volcanic origin, so the soft pummice is easily quarried yet still self-supporting however deep it is cut. By the following March, 4.8 km (3 miles) of tunnelling wound its way under the northern half of the island.

For the defenders this was as well as, in order to 'soften up' the island before the landing, both the US Navy and the US Army Air Force carried out massive bombardments. The US Navy began its assault in November 1944 with fire from the guns of six destroyers and four heavy cruisers which lasted a whole morning and was repeated at regular intervals until February, while on 8 December Consolidated B-24s and North American B-25s began an assault which was to last 72 days before climaxing on the morning of 19 February with an attack by 120 carrierborne planes, dropping

Right: Iwo Jima was defended by a labyrinth of tunnels, caves and bunkers which were invariably defended to the last man. Here a US demolition team blow in the roof of a cave connected to a three storey blockhouse, burying the surviving members of the garrison in the ruins of their position.



Below: LVTs manned by crews from the US Coastguard bring the 4th Marine Division ashore on Iwo Jima. The Japanese chose not to contest the landings initially, but put up fanatical resistance as the Marines attempted to advance off the beach. By the end of the first day 30,000 Marines were on Iwo, and the battle began in earnest.

Above: The US forces knew what to expect in terms of fortification on Iwo Jima, and began a series of preparatory bombardments in November in readiness for landings not scheduled until February. Regular shelling from warships and aerial bombing intensified in the days before the actual assault and the landings were successful.

napalm along the strip of ground just inland of the proposed landing beaches. From then on the bombardment took the form of a creeping barrage from the massive guns of seven battleships, four heavy cruisers and three light cruisers.

Four hundred and fifty vessels of the US 5th Fleet were offshore at dawn on the morning of 19 February, and around and among them swarmed 482 landing craft of various descriptions, bearing the men of eight US Marine battalions; and at 09.02 the first wave hit the landing beaches, 5th Marine Division platoons on the left, 4th Marine Division platoons on the right.

Heavy resistance

For the first 20 minutes it seemed as though the US Navy and the USAAF had done the job for the US Marines, who met only sporadic and scattered resistance,apparently totally unorganized. Then as the Marines moved up towards a low sand ridge, concentrated fire from concealed machine-gun and mortar posts opened, and a deadly rain of metal swept the 1.6-km (1-mile) strip; the most costly operation in the history of the US Marine Corps had begun.

For a matter of seconds the shock of the sudden deluge of Japanese fire froze the Marines where they lay, then training and the realities of the situation galvanized them into action. They could not stay where they were and live; they could not go back, for despite the shot and shell which furrowed the beach behind them LCVs were still swimming in through the surf, and waves of supporting companies were flooding ashore and packing the beach-head.

Sheer pressure drove the leading platoons forward out of the maelstrom behind them into and over the nearest Japanese defensive positions, some of which they destroyed, leaving others to their comrades coming up behind; and in less than an hour they had widened the beach-head to 0.8 km (0.5 mile). Seven whole Marine battalions were ashore with their essential equipment, forward patrols had reached the edge of the main airfield and another was in sight of the western beach.

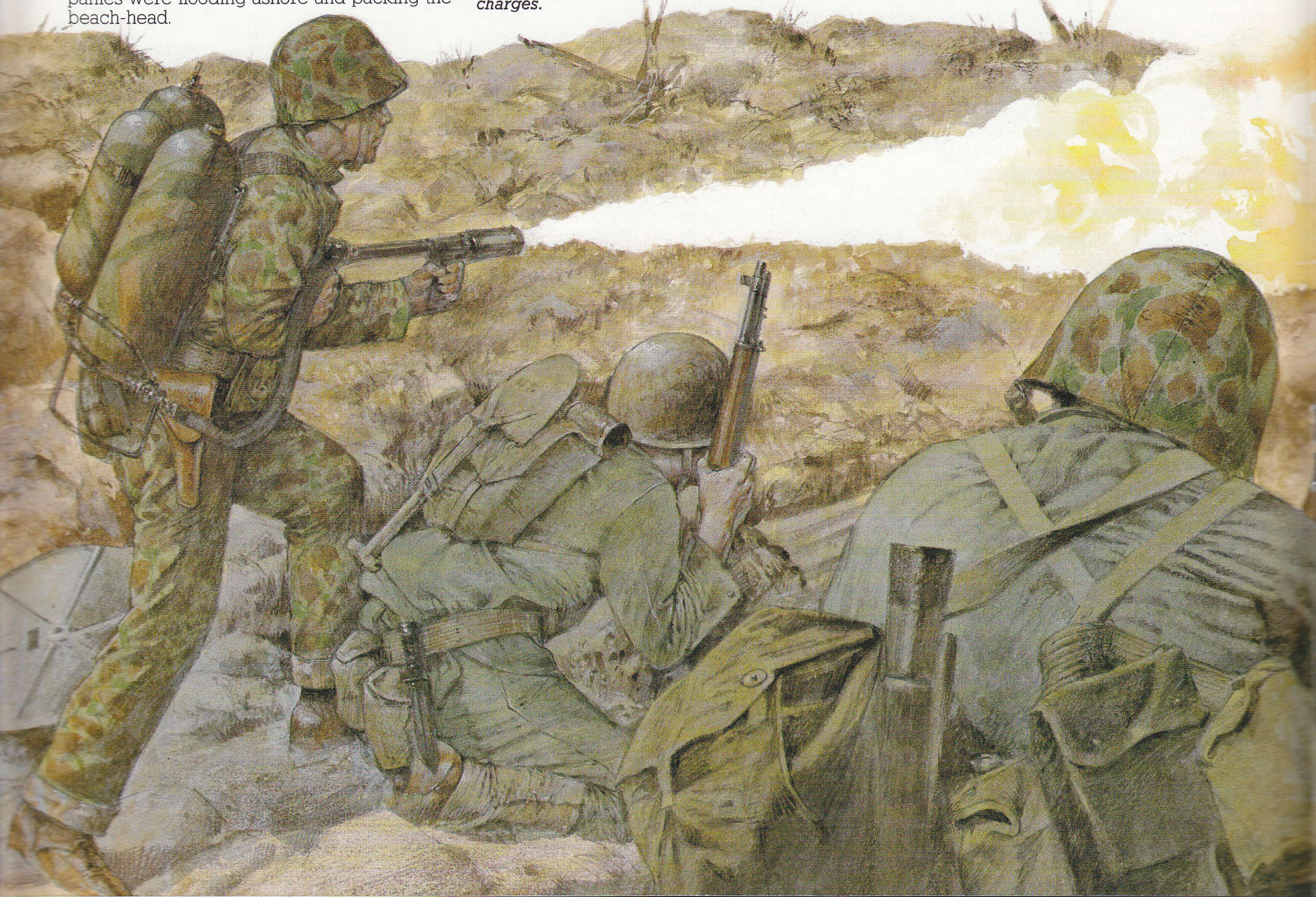
Undoubtedly Kuribayashi had made a fundamental error in allowing that first wave of Marines to get ashore, for by the end of the day 30,000 Marines and their weapons and stores had been landed, and they were there to stay. Their casualties had been high (that had been expected), but the combination of pressure from behind and desperation had flung the leading elements straight across the neck of the island, isolating Mount Suribachi and its garrison from the main defending force, and placing the southern end of the main airfield firmly in American hands.

The ensuing four days were spent in capturing Mount Suribachi (the most famous photograph in American history, of the flag being raised by a Marine patrol on the summit, was taken on 23 February), and from then on a savage battle of attrition was fought as the Marines assaulted the defence lines to the north. Bayonet, rifle, flamethrower and grenade were the weapons with which the fighting was conducted for the next 21 days, for the Japanese defenders were not only fighting from well dug-in positions, but followed the practice of waiting in deep cover until the Marines were closed up to within 45 m (50 yards) or less before manning their guns and thus betraying their positions, seemingly to vanish again after a violent spasm of vicious and costly close-quarter battle.

Japanese tunnels

Time after time the Marines moved in behind an apparently devastating barrage, to be greeted when the guns lifted by fierce resistance from virtually invisible positions. Then after half an hour of bitter and costly fighting, they would rush the post to find only a few dead Japanese and perhaps one wrecked machine-gun; and as they moved forward again the post would spring to life behind them as the defenders reoccupied the post through the tunnels.

By D+10 many Marine formations were down to half strength, and although the 3rd Marine Division had now been put ashore, it soon found itself blocked by a positive lattice of defensive positions which constituted the northern half of the island. Complexities of



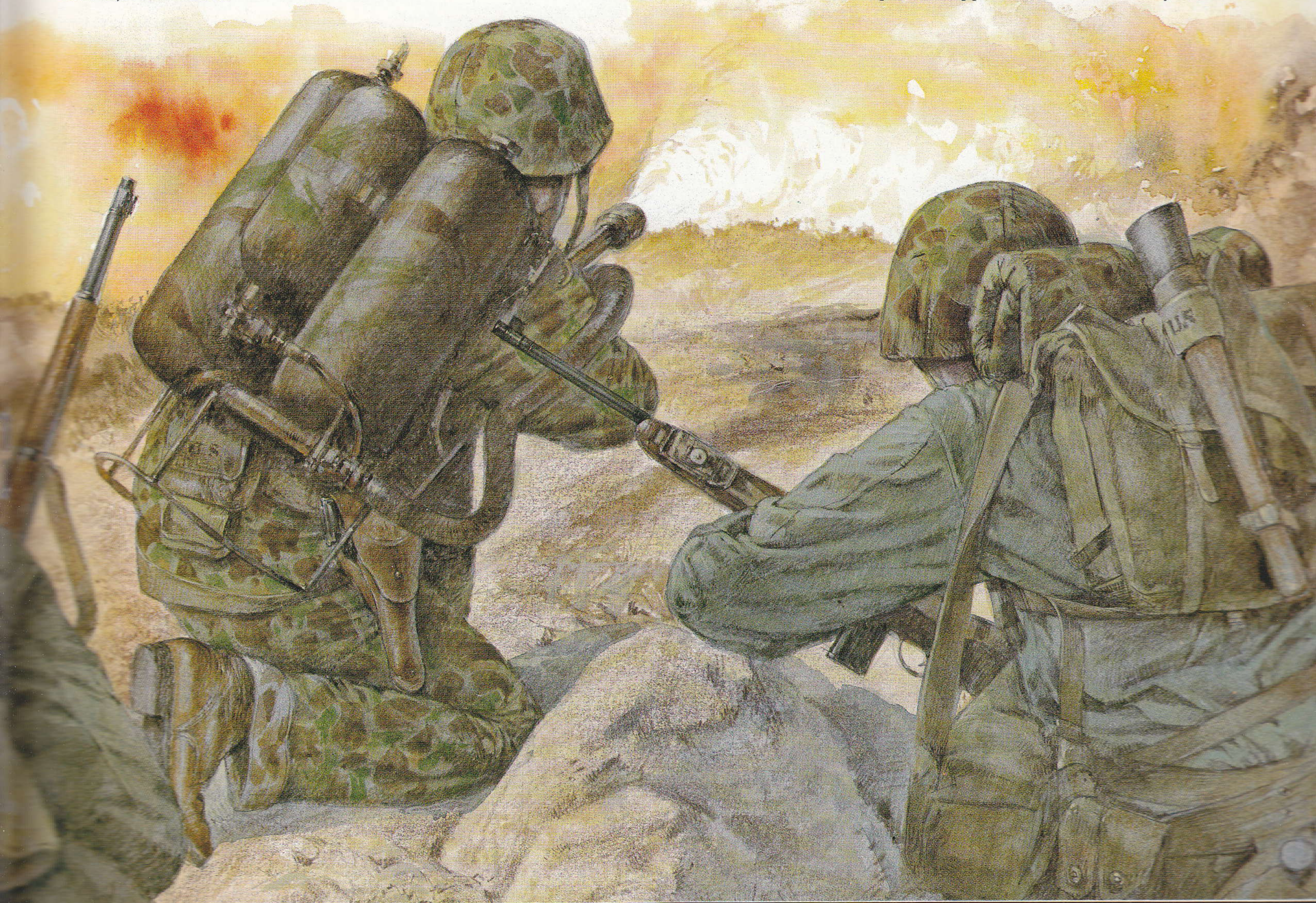
'Bunker by bunker'

The battle for Iwo Jima was the most costly operation in the history of the US Marine Corps. The moon-like landscape of the volcanic island was riddled with caves, which the Japanese had reinforced and linked to blockhouses and bunkers by a tunnel network. From their concealed positions the Japanese garrison of 21,500 men commanded by General Kuribayashi fought with fanatical courage. The Marines slowly advanced inland, engaging each pillbox with a deadly combination of flamethrower and demolition charges.

Below: The US flamethrower teams gave the defenders a horrible choice of abandoning their positions or being burned to death, but frequently the Marines would capture a position only to be ejected by a sudden Japanese counter-attack. In this bloody battle of attrition the Marines sustained over 20,000 casualties.

Above: Men of the 5th Marine Division call upon the occupants of a cave to surrender. Such pleas were invariably ignored, and the Marines would either seal the cave with explosives or pump it full of gasoline before dropping incendiaries inside.

Above: A Marine directs suppressive machine-gun fire against Japanese positions on 9 March 1945. Extensive tunnelling enabled the Japanese to appear and disappear with bewildering speed, and they knew that if they stayed sufficiently close to the Marines the Americans would not be able to provide support fire for fear of friendly casualties.



underground bunkers faced them, and mazes of interwoven caves; in one area 915 m (1,000 yards) wide and 180 m (200 yards) deep 800 pillboxes, blockhouses and dug-outs each held fanatical defenders every one of whom, it was afterwards revealed, had sworn to kill at least 10 Marines.

It was not until D+189 that the first Marine patrols reached the north east shore of the island, and then it became possible to partition the area still in Japanese hands into small pieces and gnaw away at each piece until the defence was crushed. But at last it was done. On the night of 25/26 March the last defenders launched a final *Banzai* charge against their attackers, and the following morning the bodies of the 300 devoted servants of the Emperor who had carried it out littered the ground around the entrace to their last position.

By this time the first B-29s had landed on the island's main airstrip, and by the end of March squadrons of P-51s were flying in to take up their role of escorting the heavy bombers against the Japanese mainland. It all formed a significant step in the defeat of Japan, but it had cost the Marines 6,821 killed and three times that number wounded; and of the 23,000 Japanese who had been on the island when the first landings took place, only 1,083 were ever taken prisoner, most of them badly wounded.

Iwo Jima was less than 26 km^2 (10 sq miles) in area. It had taken 72 days of air bombardment, three days of concentrated naval hammering and 36 days of the most bitter infantry fighting to conquer it.

How long, and at what cost, would it take to conquer the Japanese homelands by the same methods?

Above: The 'thousand mile stare'. The fixed expressions on the faces of these Marines as they come out of the line are eloquent testimony to the ferocity of the fighting. The resistance on Iwo Jima gave some indication of what the Allies could expect if they tried to invade Japan itself.

Below: Mount Suribachi looms over the lunar landscape of Iwo Jima as US mortars pound Japanese positions. The garrison fought to practically the last man and the body of its commander, General Kuribayashi, was never found.

USSR

ROKS-2 and ROKS-3

When the USSR entered the war in 1941, it had been developing flame weapons for some years, but at a relatively low priority. In 1941 it had a portable flamethrower type known as the **ROKS-2 (ranzewüj ognemjot K S-2)**. No details of the ROKS-1 have been discovered, but it is likely that this was a development model only. In design terms there was nothing really remarkable about the ROKS-2 apart from the attention paid to the appearance of the weapon. One of the tactical lessons learned during World War I regarding flamethrowers was that any soldier noticed by the enemy to be carrying a flame weapon immediately became the target of every weapon in sight, so if the appearance of the flamethrower could be altered in some way the user had a better chance of survival. Accordingly the Soviet designers went out of their way to make the ROKS-2 appear to be an ordinary infantry weapon. The main fuel tank was configured like a soldier's ordinary back-pack, and the flame projector was made to look like an ordinary rifle, and in fact the butt of the projector was taken from the standard Soviet Model 1891/30 rifle. The only noticeable flamethrower features were the small gas pressure bottle under the 'pack', the hose leading to the projector, and the rather prominent ignition device at the muzzle of the projector. On the battlefield these features would probably have merged into the general background.

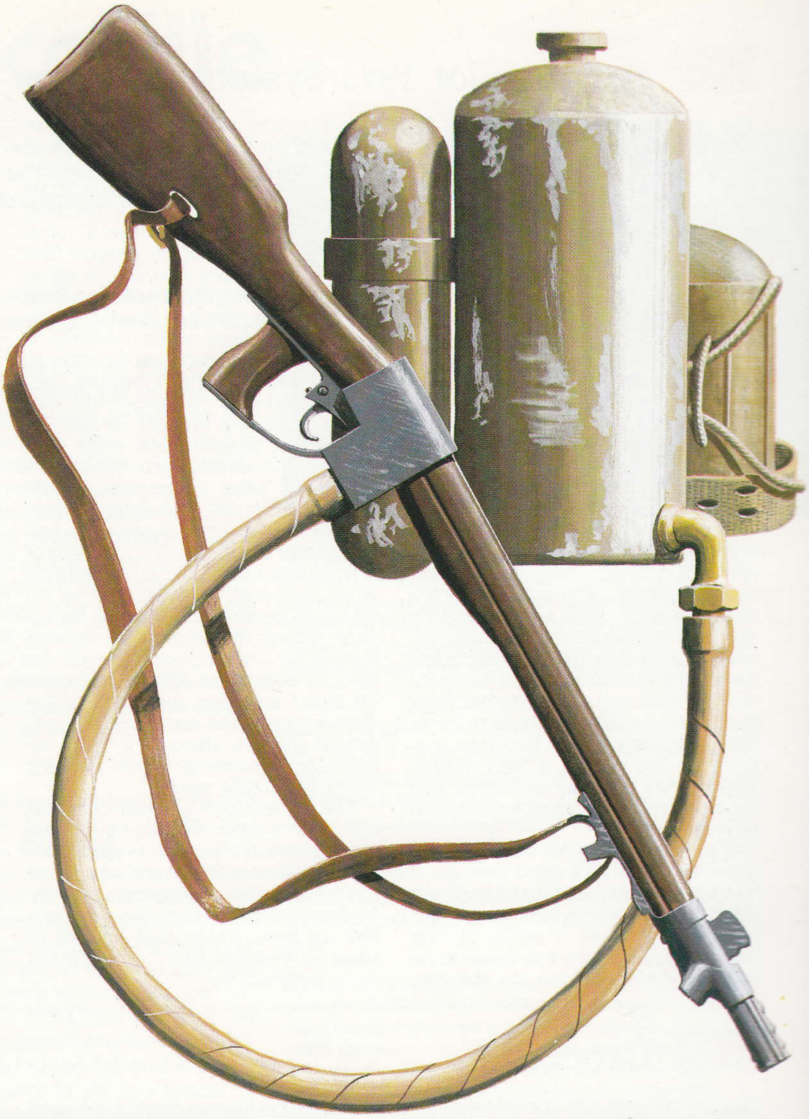
After the German invasion of the USSR in 1941 most of the nation's industrial facilities were soon in a state of upheaval as factories were overrun or moved to the east. Flamethrower production was affected along with everything else, and in the struggle to meet the ever-increasing demands for weapons of all kinds the design niceties of the ROKS-2 had to be omitted. A new and simpler model known as the **ROKS-3** came into being, and this did away with the pack appearance and instead used two cylinders on a frame carried on the back. The flame projector still resembled a rifle, but it was much simpler and easier to make in quantity.

During their investigations into flame warfare the Soviets discovered how to make the thickened fuel that improved flame effects and range, and used this new fuel in both the ROKS-2 and ROKS-3. Using thickened fuel both equipments had a maximum possible range of 45.7 m (50 yards), though operational ranges were rather shorter.

The Soviets also produced static flamethrowers of the type meant to be buried in the ground with only the projector nozzle pointing towards the target area. The exact designation of these weapons is not known, but the Germans copied them to produce their own Abwehrflammenwerfer 42. The Soviets also developed a whole series of flamethrower tanks, starting with the T-26 of the early war years. The T-26 version was no great success but in 1941 the **ATO-41** flamethrower appeared. This was installed next to the main gun of the KV heavy tank to produce the **KV-8**, and when mounted in place of the bow machine-gun of a T-34/76 tank the vehicle became the **OT-34**. These early installations were not very successful, mainly because the internal fuel capacity was only 100 litres (22 Imp gal), which limited its tactical usefulness, and there were also many technical drawbacks. Most of these were eliminated with the introduction of the **ATO-42** equipment, which could accommodate more fuel. A few of these improved equipments were installed in the KV-1S heavy tank to produce the **KV-8S**, but most of the ATO-42s were installed in place of the bow machine-gun of the T-34/85 which then became the **TO-34**. The ATO-42 could fire four or five flame bursts in 10 seconds, and the maximum range with thickened fuel was 120 m (131 yards). The Soviet flamethrower tanks were used in special three-company battalions.

Specification

ROKS-2
Weight: 22.7 kg (50 lb)
Fuel capacity: 9 litres (2 Imp gal)
Range: 36.5 to 45.7 m (40 to 50 yards)
Duration of fire: 6 to 8 seconds



Right: The Soviet ROKS-2 was carried as a back pack with the cylinder tanks vertical. The flame gun was designed to resemble a rifle to conceal its function, as flamethrower operators usually attracted a great deal of enemy attention and fire. The large tank contained enough fuel for about eight seconds of use.

Below: Finnish troops surround a Soviet OT-26 flamethrower tank in 1941. This was a version of the twin-turret T-26 light infantry tank, with internal fuel tanks taking the place of one of the turrets and the other mounting a flame gun.

USSR

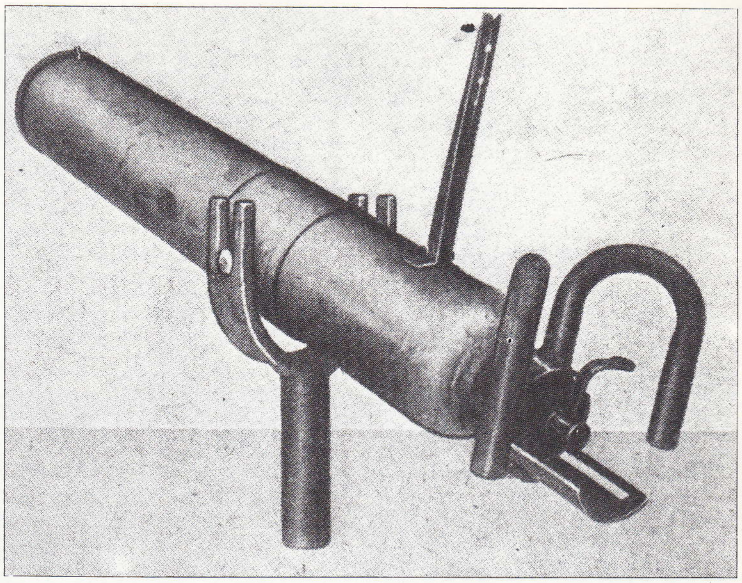
Ampulenjot 1941 System Kartukov

The weapon that was known as the **Ampulenjot 1941 System Kartukov** appears rarely in Western literature and it is still something of a mystery weapon. It was not a flamethrower in the usual sense used elsewhere in this study, but rather an incendiary projectile launcher. During World War II these were little used by any combatant, although there were plans to produce similar weapons in the UK during the dangerous days of 1940; the abortive Newton Mortar was one of these. The Kartukov gun appears to fall into exactly the same category, for it was produced in 1941 when the German army was rapidly overrunning most of the western areas of the USSR.

These western areas contained the vast bulk of the USSR's industrial potential. As many as possible of the machine tools and other raw materials of production were hurriedly uprooted and taken away to the east beyond the Urals. During this period of reorganization and confusion the Soviet Army was losing vast quantities of war weapons of every kind, and something had to be produced quickly to replace them. This was where the Kartukov gun came in, for it was a very simple weapon that could be produced with the absolute minimum of facilities and raw materials.

The Kartukov was what is now generally know as a 'pipe gun', i.e. it was simple length of steel pipe closed at one end and with a minimum of fire-control equipment. It would appear that the Kartukov gun was meant to be used at static locations, for the only illustrations seen show the gun mounted on a simple yoke arrangement mounted on a steel post. There were no elevation or traverse controls other than two rudimentary handles, located behind the 'breech', with which the firer aimed the weapon. The breech itself was a very simple affair: when opened, the breech block moved back along a short slide to allow the charge to be inserted. It seems almost certain that the charge was only a small black-powder cartridge and that the projectile was loaded from the muzzle. To aim the weapon a fixed raised sight that aligned with a small 'pip' on the muzzle was used, holes in the raised sight being used to vary the range. Firing was by percussion. The projectile had a diameter of 127 mm (5 in) and was of a type once known during the Middle Ages as a 'carcass'. This was an incendiary device that burst into flames as it struck the target and spread flames or burning material in the general target area. Although it cannot be stated for a fact, it seems that the Kartukov gun used some form of phosphorus mixture allied to a thick oil-based fuel. The range at best was only about 250 m (274 yards).

The advancing Germans captured numbers of these Kartukov guns, and the only references now available regarding these weapons are to be found among German intelligence reports. Understandably enough the Germans did not have a very high opinion of them as weapons and they regarded them as 'primitive'.



The Soviet Ampulenjot 1941 System Kartukov was a simple 'pipe' gun that used a small black powder charge to fire an incendiary 'carcass' projectile. It was an expedient defence weapon used for a short period in 1941. The maximum range was only 250 m (274 yards).

It would appear that by 1942 the Kartukov guns were no longer required and were scrapped.

Specification

Ampulenjot 1941 System Kartukov
Calibre: 127 mm (5 in)
Length: overall 1.02 m (40.16 in)
Weight: 26 kg (57.3 lb)
Elevation: 0 to +12°
Traverse: 360°
Muzzle velocity: 50 m (164 ft) per second
Maximum range: 250 m (274 yards)
Projectile weight: 1.5 or 1.8 kg (3.3 or 3.97 lb)

UK

Crocodile

The first general staff specification for a flamethrowing tank was put forward as early as 1938, although at that time there was no research department dealing specifically with flame warfare. Some desultory trials led to a number of experimental models, but nothing definite was achieved until a special Petroleum Warfare Department was established, and then some more definite work was commenced. The PWD concentrated on a type of projector that used compressed hydrogen to propel the flame fuel jet, and in time this led to the **Crocodile**.

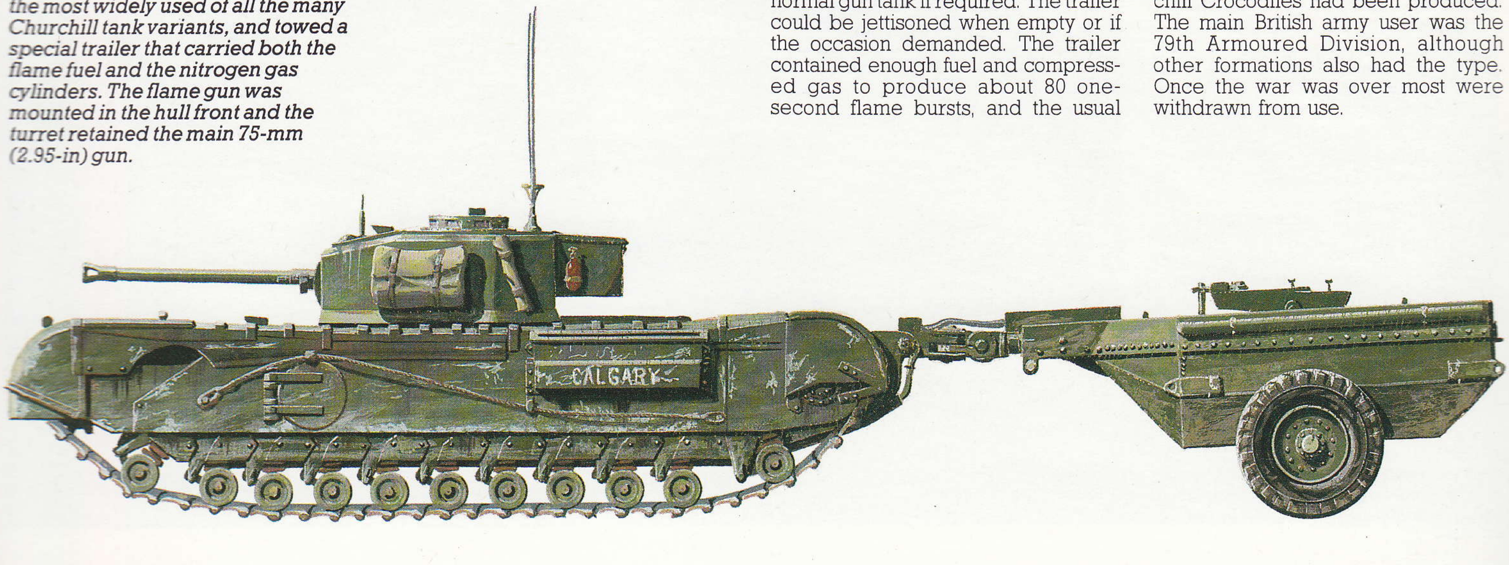
The Churchill Crocodile was one of the most widely used of all the many Churchill tank variants, and towed a special trailer that carried both the flame fuel and the nitrogen gas cylinders. The flame gun was mounted in the hull front and the turret retained the main 75-mm (2.95-in) gun.

The Crocodile was meant to be used with the Churchill infantry tank, hence **Churchill Crocodile**. When it first appeared in 1942 a change of War Office policy meant that there was officially no longer a requirement for the flamethrower tank, but work nevertheless went ahead. It was just as well, for in April 1943 another policy change meant that the Crocodile was wanted once more and in August 1943 an order for 250 was placed, these vehicles being needed to equip units that would take part in the forthcoming Normandy landings.

The order was made despite the fact that no troop trials had taken place. Although the initial plan was that the Crocodiles were to be mounted on the Churchill Mk IV, most production weapons were installed in the Churchill Mk VII. The main part of the Crocodile was installed in a two-wheeled trailer towed behind the Churchill tank and connected to the tank via a universal joint through which the pressurized fuel had to pass. The projector itself was at the front of the tank, installed in place of the hull machine-gun. The Churchill's main 75-mm (2.95-in) gun and turret machine-gun were retained to enable the vehicle to be used as a normal gun tank if required. The trailer could be jettisoned when empty or if the occasion demanded. The trailer contained enough fuel and compressed gas to produce about 80 one-second flame bursts, and the usual operational range was about 73 m (80 yards), although under favourable conditions 110-m (120-yard) range was possible.

The Churchill Crocodiles first went into action on D-Day, 6 June 1944. Thereafter they were used in all theatres of war and came to be very effective weapons that were greatly feared by the enemy. There were plans for Crocodiles to be used on Sherman tanks operated by the US Army and although some design work was carried out only six were built and of those only four were used in action by the Americans in Europe.

By the time the war ended 800 Churchill Crocodiles had been produced. The main British army user was the 79th Armoured Division, although other formations also had the type. Once the war was over most were withdrawn from use.



The Churchill Crocodile

First used in action during the D-Day landings, the Churchill Crocodile proved to be the most successful flamethrower tank of the war. In the battles across France and Germany the appearance of a Crocodile spraying liquid fire was enough to shatter the nerve of the most resolute defence.

By 1944 the Churchill tank was of limited use as a battle tank, so its conversion to the Crocodile flame role provided it with a useful lease of life. Although slow and ponderous the Churchill was ideal for the close support flame role as it was well protected and was able to retain its main gun.

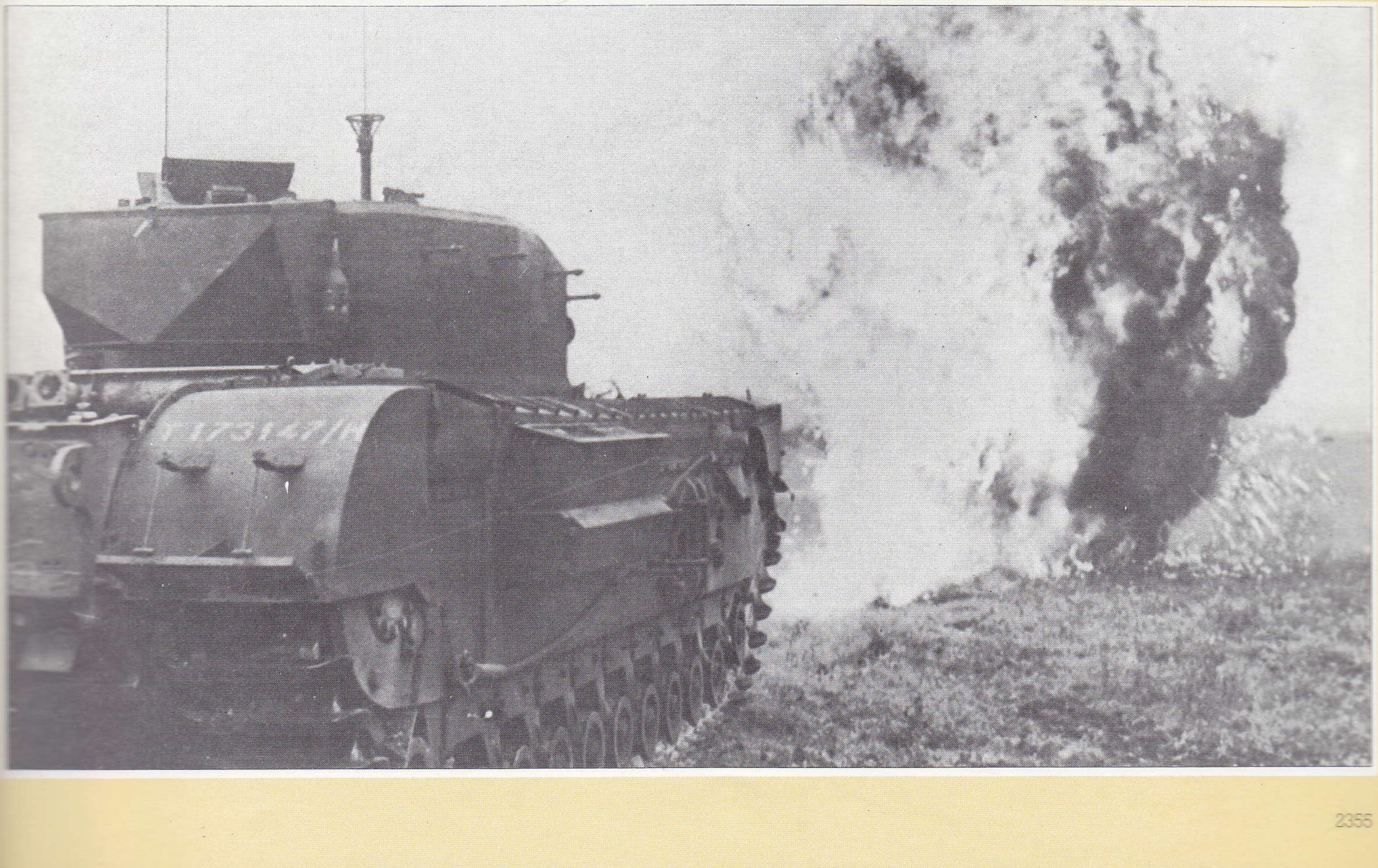
The Crocodile had an inauspicious start to its service career. Out of the six that were supposed to have landed at H+45 on D-Day (6 June 1944) only two survived: two troops of Crocodiles, each of three tanks, were to have landed, but all the vehicles of one troop became casualties of the rough seas or beach obstacles, and in the other troop one vehicle foundered in an underwater crater. The two that struggled ashore found themselves being used not as flamethrower tanks but as ordinary gun tanks in support of the 7th Battalion, The Green Howards, and at times on that momentous day the infantry swarmed onto the Crocodiles as they cleared their way through the village of La Rivière.

These two Crocodiles belonged to the 141st Regiment, Royal Armoured Corps (141 RAC), the first unit to be equipped with them. When 141 RAC landed it had been given only a very short period of time to train with its new equipments, and it was about to learn how to use its novel charges operationally, literally in the heat of battle. On the morning after the landing the Crocodiles and their crews stood to on the outskirts of the small village of Crepon, and when it was light they found themselves only a few hundred metres from a German artillery battery hidden in a wood. A hasty attack was planned using nearby gunners and signallers as infantry, with two Sherman Crabs acting as gun tanks. The Crocodiles moved forward and fired only eight flame shots before the wood became a mass of white flags as 150 Germans moved forward to be taken prisoner. The surprise use of flame had completely demoralized the battery: it was an encouraging augury for the future.

Over the next few days the two Crocodiles were again used as gun tanks, but meanwhile the vehicles that had foundered on the first day were recovered and on 14 June they had a brush with a troop of Panther tanks, resulting in two Panthers being knocked out (by guns, not by flame) and one Crocodile damaged. Following this scrap the nearby village of La Senaudière was flamed in a spectacular action and the occupying Germans were driven out. During this flame action one Crocodile was destroyed by a German tank. Once this action was over the two D-Day troops were withdrawn. Their brief operational life had been busy, but little was learned about the operational use of their flame weapons.

Early actions

This was to become very apparent once the remainder of 141 RAC landed in France between 22 and 24 June. Almost as soon as they landed the squadrons were broken up into small groups in support of various formations. The commanders of these formations often had no knowledge of flame tanks and even less idea of how to use them in action, and the period that followed was unfortunate for the Crocodile crews. All too often they were called upon to take part in actions where their capabilities could not be used to the full and at times they were simply asked to do too much. A typical example was the action at La Bijude on 8 July. A squadron was supposed to take part in an attack but as a result of the administrative dislocation of the squadron, which was spread out over a wide front, two troops did not even start. As a third troop moved forward one Crocodile was knocked out by a German rocket-launcher and another was hit by an anti-tank gun. Fortunately the fourth troop appeared and in a spectacular flame action cleared the village.



One of the main users of the Churchill Crocodile was the 79th Armoured Division, which had three regiments equipped with them. Other regiments were formed later, but the Churchill Crocodile was used only during the last year of the war in Europe and was mainly retained in support of infantry operations.

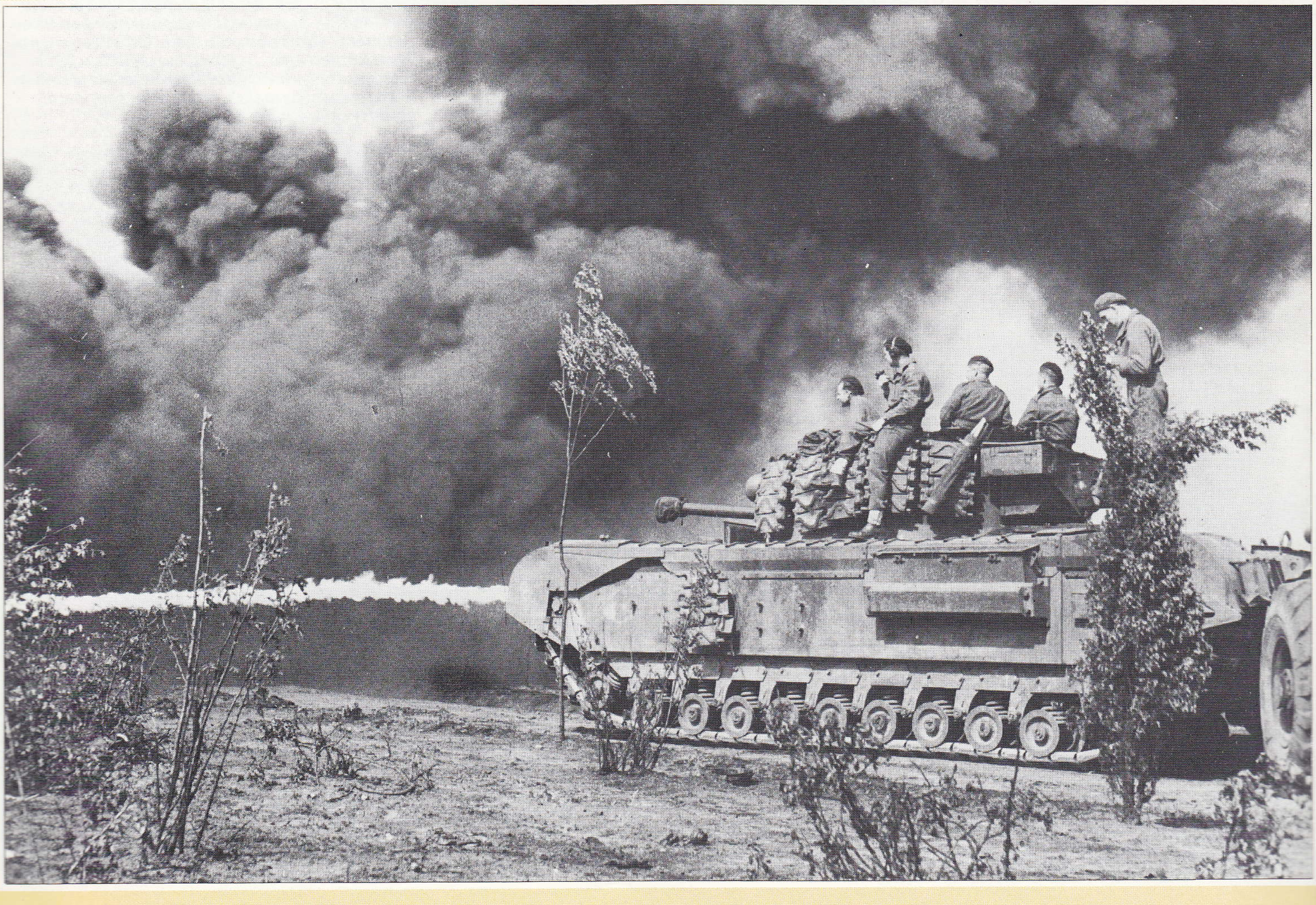
Apart from the enemy-inflicted casualties, one Crocodile that took part in this action was unable to function for purely technical reasons. Before a Crocodile could be ready for action the nitrogen or inert gas used to pressurize the system took about 30 minutes to work up to operating levels. Once at operating pressure the Crocodile system became prone to leaks and other malfunctions that could render the system inoperative. All too often the Crocodiles had to fit into attack plans made by other formation commanders who did not appreciate or understand these technical points, so all too often any delays or holds meant that some became inoperative. At other times co-operation between the infantry and the Crocodiles was not as good as it might have been, and all too often reconnaissance was either hasty or incomplete, leading to some nasty moments and casualties.

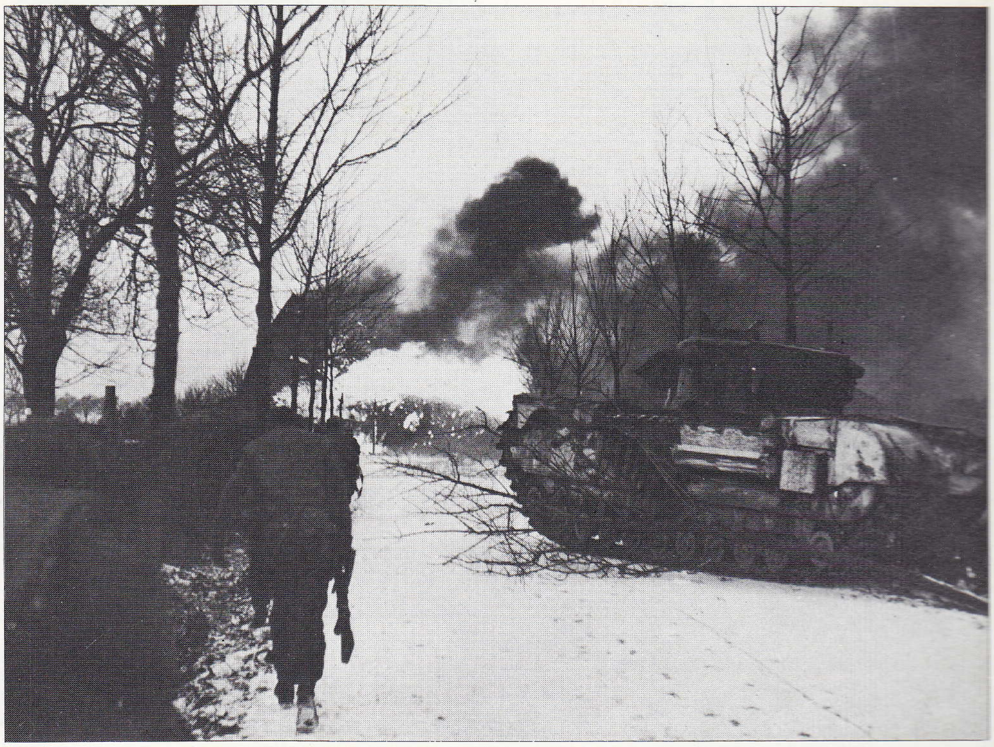
Assault on Carpiquet

Not all these early actions were abortive, for some small-scale actions were great successes. Very often the German defenders either gave up or simply moved off to the rear as soon as the first flame shots were made. Sometimes, such as during a Canadian action against the airfield at Carpiquet, the Germans attempted to leave their trenches and swarm all over the advancing Crocodiles and their trailers. This highlighted the need for supporting infantry during such actions, but in the event the Germans were beaten off by Besa machine-gun fire from another Crocodile troop.

Above: During 1944 and 1945 the German army made use of all sorts of cover to form defensive strongpoints that could only be reduced either by heavy artillery fire or by flamethrowers. The Churchill Crocodile was widely used to deal with them.

Below: One unpleasant task carried out by Churchill Crocodiles was the burning of the typhus-ridden huts at the Belsen concentration camp after the unfortunate occupants had been removed. Evacuating them took many weeks, during which the contaminated huts remained infectious to all who entered them.





A Churchill Crocodile opens fire on the fortfied village of St Joost, supporting an attack by two platoons of the 1st Rifle Brigade in January 1945. Flamethrowers were excellent weapons for suppressing defensive fire. Here the attacking infantry hurry along the road while the Crocodile ensures the Germans have their heads down.

It was during this July period that the use of flame against concrete defensive structures became an established procedure. If a bunker had weapons slits the flame jets could easily get inside and clear the unfortunate occupants from the interior. However, if the interior rooms were sealed by doors and gas seals the occupants were unaffected by the flame and were able to remain unharmed for as long as they liked. This was rarely long, for the opening flame jets were usually enough to make any such occupants lose any ideas of holding out.

By the end of July the Crocodiles had earned the respect of Allied commanders, who increasingly gave them the lead in the planning of attacks. Gradually the Crocodile commanders were given the chance to plan their own actions, carry out their own reconnaissance and, perhaps most imprtant of all, say whether or not the Crocodiles could carry out a specific task. These changes brought about the use of Crocodiles in larger numbers than the previous one- or two-troop actions, during which some vehicles usually had to drop out as a result of technical failures.

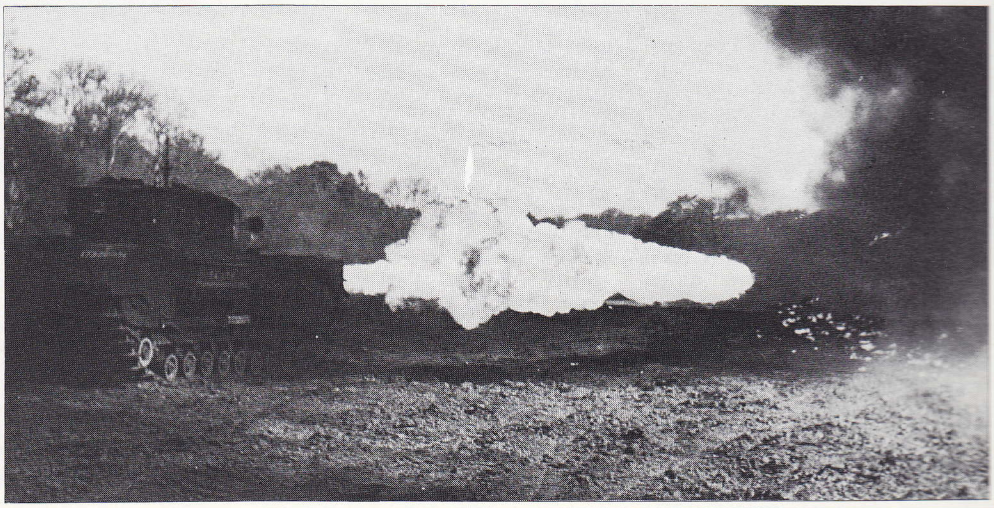
Squadron attack

The first squadron action was against May-sur-Orne on 8 August. Infantry attacks had previously failed to clear the village of the enemy, who were well dug in. Three Crocodile troops took part in the attack under fire support provided by the gun tanks of the troop commanders, and by a barrage laid down on the village itself. As the Crocodiles moved forward they used their main guns to blow a hole in each building, through which jets of flame were then directed to clear the interior, and any ditch or hiding place likely to be used by the enemy was liberally doused with flame. The infantry moved up close behind the Crocodiles and continued the clearing process. The operation was a complete success. The Germans left the village, and the attacking Crocodiles and infantry suffered no casualties at all. Operations such as this continued all through August.

Channel ports

By the end of August 1944 the Allies were advancing at such a speed that not only could the slow-moving Crocodiles not keep pace but there was little for them to do. They accordingly settled down for a brief respite of rest and repairs to their trouble-prone vehicles. But their rest was to be short-lived, for although the Allies had advanced almost to the French borders in places, the Channel ports in their rear were still held by their German garrisons. The Crocodiles were used during their subsequent investments and in one of these actions, at Le Havre, the Crocodiles were used for the first time during a night action. This took place on the night of 10 September, when the flame guns were initially fired well outside their maximum range of any target. The sight of the approaching jets of flame had a terrifying effect on the enemy, who promptly surrendered. This short operation made a hole in the Le Havre perimeter defences and on the following day the process was repeated with similar success. It was during the Le Havre operation that an entire German platoon was caught in the open by a Crocodile attack and every man in the platoon was burned to death. Similar operations were carried out at Brest, Calais and Boulogne.

The autumn operations of 1944 rarely needed the use of flame tanks, and those flame operations that were required were usually carried out by Wasps. During October 141 RAC was joined by the Crocodiles of the 1st Fife and Forfar Yeomanry and from then on the two regiments both took part in some of the actions that took place in the aftermath of Operations 'Market ' and 'Garden'. The battles of the approaches to the Rhine followed, with the clearing and capture of Frasselt, Cleve, Gennep, Hassim and Goch. In the close fighting that took place in the gloomy Reichswald the Crocodiles were the only weapons that could be used for effective support of the infantry, the long tongues of flame being able to clear the Germans from their forest defences where tanks could not make their way through the closely-wooded undergrowth. All through February and March 1945 both Crocodile regiments were kept active, flaming their way through the area between the Rivers Maas and Roer, to make the west bank of the mighty Rhine clear for the forthcoming Operation 'Veritable', the crossing of the Rhine itself. By that period the Crocodile was an established weapon. Its potential was understood and its technical drawbacks were such that they could be accommodated; and they were greatly feared by the enemy. All through that last winter of World War II the Crocodiles supported British, Canadian and American troops, and whenever they appeared and were used properly they won the day. By the end of March 1945 three Crocodile regiments were in the field, and they stood ready to cross the Rhine into Germany.



The Churchill Crocodile had a normal operational range of about 73 m (80 yards), although under favourable conditions they could manage 110 m (120 yards). Enough fuel was carried for 80 one-second bursts, but this was rarely attained as the gas cylinders were prone to leakage.

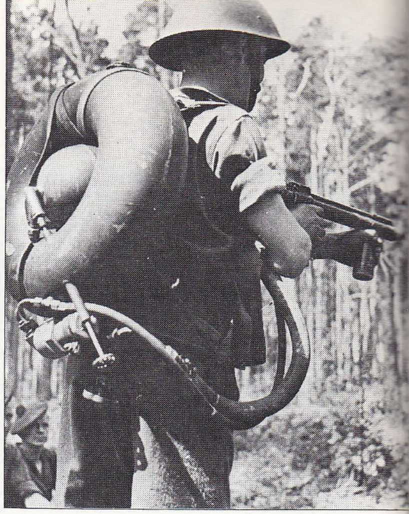
UK

Lifebuoy

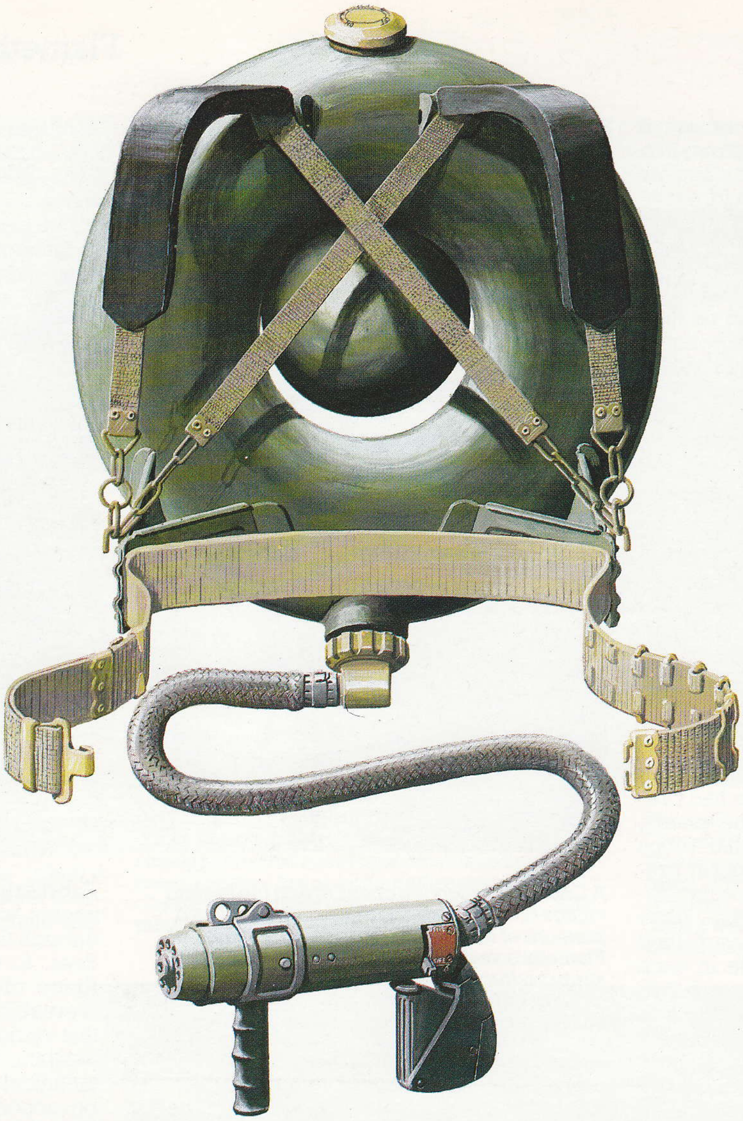
Development of what was to become officially known as the **Flame-Thrower, Portable, No. 2 Mk I**, began during 1941. It appears to have been influenced by the German Flammenwerfer 40, but the basic design of any portable flamethrower is fixed by physical constraints. This results from the fact that for a vessel that has to contain gas at high pressure the sphere is the best possible shape. On a flamethrower the fuel tank has to contain as much fuel as possible within as small a volume as can be managed. These design criteria virtually dictate the shape of the resultant equipment, i.e. a central sphere with a fuel tank having a circular cross-section wrapped around it. This produces the classic shape which gave the British equipment its **Lifebuoy** nickname, a name that stuck.

The first pilot model was ready by mid-1942 and a production order soon followed, despite the fact that the usual series of troop and other trials had not been completed. This was unfortunate, for after only a short time in service the Lifebuoy began to demonstrate a number of serious defects, many of them caused by hurried manufacture of the complex shape of the tanks. As always, ignition proved to be somewhat unreliable, and the position of the fuel valve under the tanks proved to be awkward to use in action. As a result the first production run of the Lifebuoy, the Mk I, was withdrawn and used for training only from mid-1943 onwards. It was not until the following year that the improved **Flame-Thrower, Portable, No. 2 Mk II** appeared. It was this version that the British army used until the war ended, and for many years after. In appearance there was little to differentiate the Mk I from the Mk II.

The Mk II was ready for service by June 1944, and was used during the Normandy landings and after them, including the campaigns in the Far East. However, the British army never was really enthusiastic regarding portable flamethrowers and decided that not many would be required. Production of the Mk II ended as early as July 1944, after 7,500 had been made. Even the Mk II proved to be generally unreliable as it depended on a small battery to ignite the flame, and in the wet or after even a short period of use the battery often failed. The old production problem of quality control was carried over as well, and as always the troops complained about the weight.



Above: The Mk I version of the Flame Thrower, Portable, No. 2 was usually known as the Lifebuoy from its shape, but it was not a great success and saw only limited operational use before being replaced in late 1943 by the Mk II.



Left: The Mk II version of the Lifebuoy became the standard British flamethrower from early 1944 onwards, but it was never a popular weapon and was used operationally only in limited numbers. Its shape was chosen to provide the maximum possible volume inside a pressure vessel.

The official solution was to produce a smaller device known as the **Ack-Pack** which weighed 21.8 kg (48 lb), not for use in Europe but for possible use in the Far East. In the event the Ack-Pack was given such a low development priority that it was not produced until after the war was over. So ended the rather unfortunate Lifebuoy project.

Specification

Lifebuoy

Weight: 29 kg (64 lb)

Fuel capacity: 18.2 litres (4 Imp gal)

Range: 27.4 to 36.5 m (30 to 40 yards)

Duration of fire: 10 seconds

UK

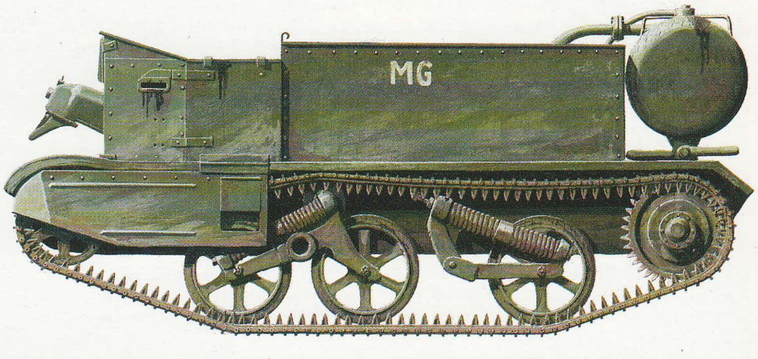
Wasp

The first British use of flamethrowers in connection with mobile warfare was during 1940, when the newly-established Petroleum Warfare Department developed a flame projector known as the **Ronson**. This had a relatively short range and was mounted on a Universal Carrier with the fuel and compressed gas tanks over the rear of the vehicle. For various reasons the British army decided not to proceed with the Ronson, requesting more range, but the Canadians persevered with the design, and later in the war it was adopted by the US Army, who called it the **Satan**.

By 1942 the PWD had developed the Ronson to the stage where ranges of 73 to 91.5 m (80 to 100 yards) were being reached, and this improved device was put into production as the **Wasp Mk I**. In September 1942 an order for 1,000 was placed and by November the following year all had been delivered. These Wasp Mk Is used a large projector gun that was routed over the top of the Carrier and connected to two fuel tanks inside the Carrier hull. However, these Mk Is were deemed unsuitable for service as by then a **Wasp Mk II** had appeared with a much smaller and handier flame projector mounted at the front in place of the machine-gun otherwise carried. This new flame projector was a great advance over the previous design and gave a much better flame performance even though there was no improvement in range; the same type of projector was also used with the Churchill Crocodile. It was also easier to aim and much safer to use.

The Wasp Mk II first went into action during the Normandy fighting of July 1944. They were used mainly in support of infantry operations, whereas the Crocodile was used in conjunction with armoured formations. They were dreadfully effective weapons, and greatly feared by the unfortunate Germans who had to bear their effects, though for fear of these effects German infantry opposition very often ceased once the Wasps had arrived on the scene.

It was not long before the Wasp Mk IIs were joined by yet another Wasp variant, this time the **Wasp Mk IIC**, the suffix denoting Canada for the Canadians had also developed their own version of Wasp. They decided that to devote a Universal Carrier to the flamethrower role only was rather wasteful in vehicles and they redesigned the Wasp so that the Carrier could also function as a normal Carrier if it had to. Accordingly they moved the fuel tanks to a location outside the rear of the vehicle, and replaced the arrangement of two tanks with a single 341-litre (75-Imp gal) tank. This gave room inside the open hull for a third crew member, who could carry a light machine-gun. This gave the Wasp Mk IIC much more tactical flexibility, and it gradually came to be the preferred type. In June 1944 all Wasp production was switched to the Mk IIC standard, and field conversions were also made,



The Wasp Mk IIC was the Canadian version of the British Wasp, and carried its fuel in a single tank at the rear; the British Wasp Mk II had two internal tanks. The Wasp was a conversion of the Universal Carrier for the flame role first tested in 1943.

using the existing Mk II 272.7-litre (60-Imp gal) tanks. Operational experience demonstrated the need for more frontal armour, and many Wasp Mk IICs were fitted with plastic armour over the front hull plates.

Some Wasps were fitted with special smoke-producing equipment, and a few had wading screens installed for possible use during amphibious operations. The Canadians demonstrated their interest in flamethrower tanks by fitting Wasp equipments to old Ram tanks to produce the **Badger**. These conversions were carried out in the UK for the Canadian 1st Army. Early Badgers did not have turrets, though later versions did, the turretless versions being based on Ram Kangaroo personnel carriers. They were used by the Canadians from February 1945 onwards.

During early 1945 three Wasps and a quantity of their thickened fuel were sent to the USSR. What the Soviets made of them has not been recorded.

The Wasp Mk II differed from the earlier Mk I in having a much smaller flame projector mounted in the front hull. British Wasps had a crew of two while the Canadians had three, one of whom usually operated a machine-gun or light mortar.

UK

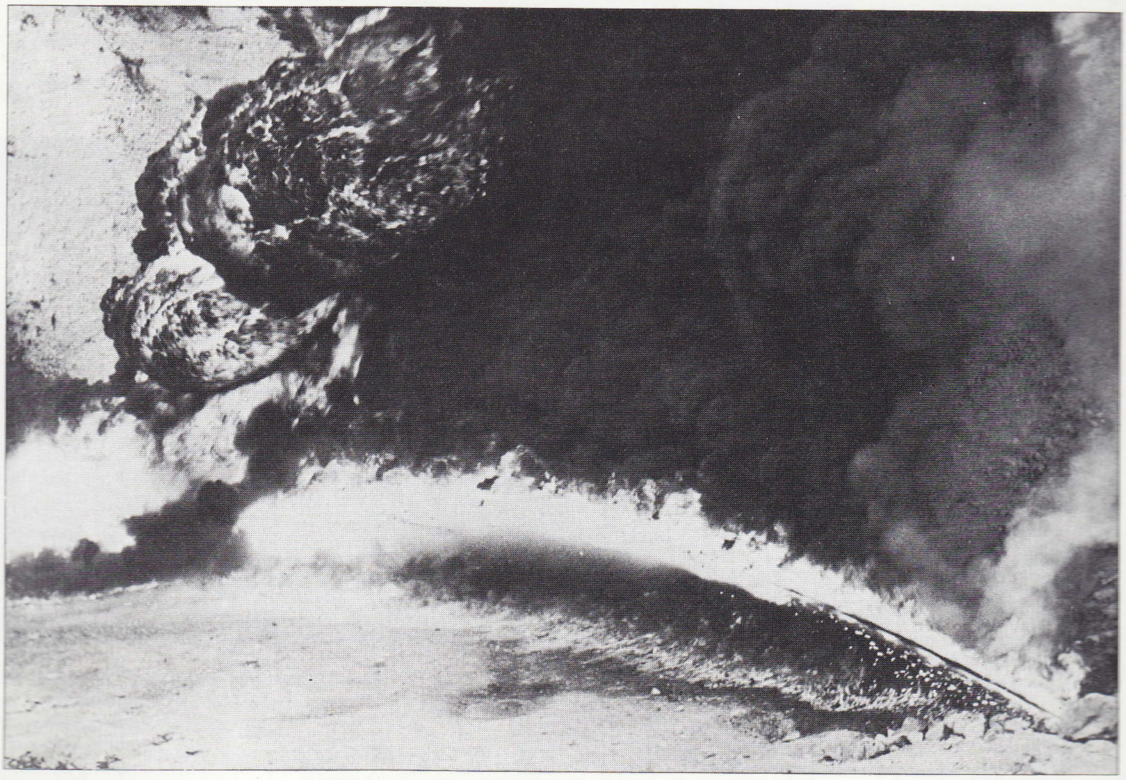
Harvey flamethrower

In the grim period after the Dunkirk evacuation of 1940 it appeared to be very likely that the Germans would invade the UK. If they had actually done so things might well have been to their advantage, for the remains of the British army in the UK were few in number and ill-equipped with virtually every kind of military necessity. Even rifles were in short supply at one point, and items like flamethrowers were virtually nonexistent. However, it was decided to produce and issue whatever could be procured.

Fortunately for the British, things like flamethrowers were relatively easy to produce as long as nothing fancy was required. Thus the **Harvey** flamethrower was born by simply knocking together what was available and handing it over to the troops. The Harvey flamethrower was officially known as the **Flame-Thrower, Transportable, No. 1 Mk I**, but to the troops it was simply the 'Harvey'. In many ways it resembled the German *Flammenwerfer* of World War I but it was not intended that it should be used as a portable weapon. Instead it was taken to wherever it was to be set up and left for possible use. The 'Transportable' part of the designation was derived from the fact that it could be moved about on a two-wheeled carriage based on wheels taken from agricultural machinery production lines. The main fuel tank was an easily-manufactured pressure tank and the compressed air used by the weapon was contained in an ordinary commercial compressed air cylinder.

The flame projector was connected to the fuel tank by a 9.14-m (30-ft) hose, and the projector itself was a simple device held in position on a monopod. The idea was that the Harvey would be taken to a selected site and set up with the tanks under cover (probably behind a wall) and with the projector and hose near the target point, probably camouflaged in some fashion. When a potential target approached the flame was ignited as the fuel rushed through the projector under pressure.

The first Harveys were issued to regular troops defending the UK, but it was not long before the Home Guard got them as well. They were cumbersome things and were not greatly liked, but they worked after a fashion. Some of them even found their way to the Middle East where they were used not for flame work but for smoke production. They were never used operationally in a flame role.

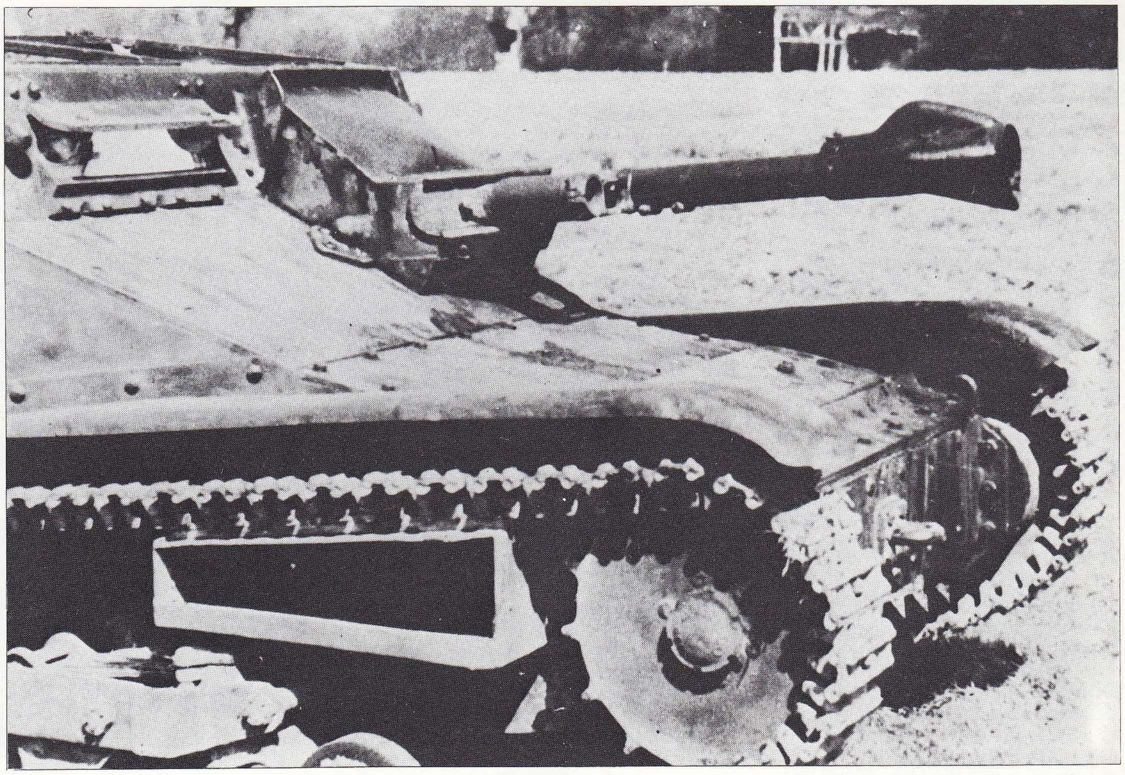


This was the flame jet produced by the Harvey flamethrower, a static defensive device produced in 1940 mainly for the Home Guard. Although meant to be used in a static role, it could be moved on a simple two-wheeled carriage, but it was a cheap and crude weapon.

Specification

Harvey
Weight: not known
Fuel capacity: 127.3 litres (28 Imp gal)
Range: about 46 to 55 m (50 to 60 yards)
Duration of fire: 12 seconds

Lanciafiamme modello 35 e 40



Above: The flame projector of the L3 Lanciafiamme was mounted in place of the machine-gun carried on the L3/38 tankettes. These flamethrower tanks were of very limited tactical value as they were very lightly armoured and had a crew of only two.

As its designation implies the Italian **Lanciafiamme modello 35** entered service in 1935, just in time to make its operational debut during the Italian invasion of Abyssinia. There this flamethrower terrorized the hapless natives who had to endure its efficiency, and from this the weapon gained for itself a reputation for lethality within the Italian army.

From a design viewpoint there was nothing really remarkable about the modello 35. It was a relatively portable twin-cylinder back-pack equipment that used a rather cumbersome flame projector. This projector was fitted at the end with a large collar housing the flame ignition system. For various reasons this ignition system was not considered reliable enough, so it was modified to produce the **Lanciafiamme modello 40**. In general appearance and use the modello 40 was otherwise identical to the modello 35.

These flamethrowers were used by special troops known as Guastori, or assault pioneers. In action these flamethrower troops had to wear thick protective clothing and their faces were covered by normal service gas respirators. When so clothed their operational mobility and vision was restricted, so they were usually guarded by teams of supporting infantry. On the move their flamethrower equipments were usually carried on special brackets fitted to trucks or, if the formation was not mechanized, mules with special harnesses were employed. The fuel for the flamethrowers was carried in specially marked jerricans.

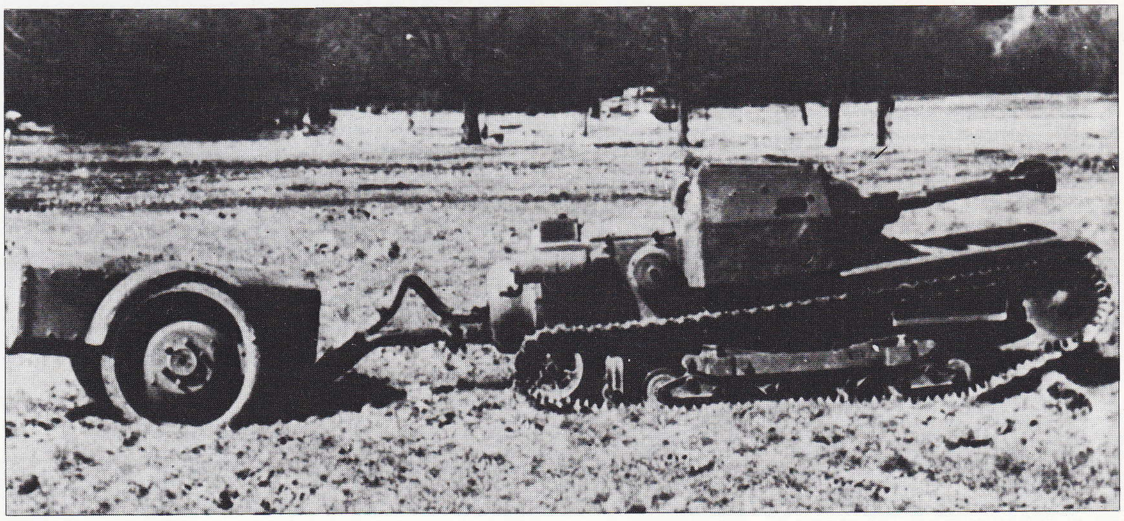
Both of these flamethrowers were used in some numbers by Italian troops operating in North Africa and by the hapless Italian troops who had to fight alongside the Germans on the Eastern Front. In both theatres of war the modello 35 and 40 worked well enough, but it was increasingly noticed that they lacked range compared with contemporary equivalents, and especially the later German designs. This did not stop the Germans from using them from time to time when it suited them.

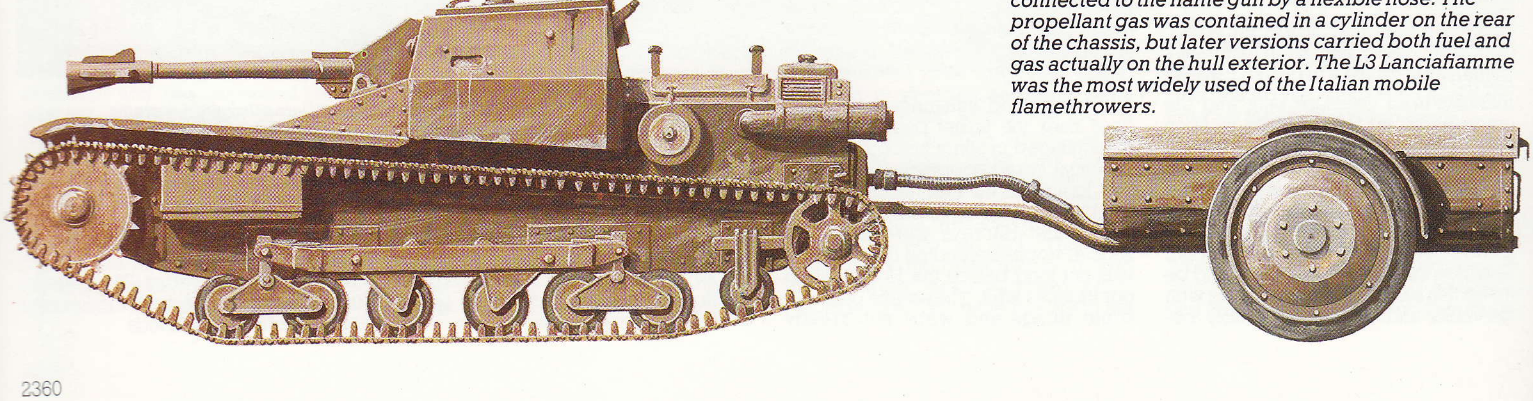
Incidentally, the success of flamethrowers in Ethiopia moved the Italian army authorities to fit a special version of a lanciafiamme, much larger than the man-pack version, to the little L.3 tankette. As space within the low hull of this **L3-35Lf** vehicle was very limited the fuel was carried externally in a lightly armoured trailer, with a corrugated pipe passing the fuel to the projector from the trailer. There was also a version that dispensed with the trailer and carried a much smaller flat fuel tank over the top of the vehicle rear. Although much was made of these two flame-throwing tankettes they appear to have been little used.

Specification

Lanciafiamme modello 35
Weight: 27 kg (59.5 lb)
Fuel capacity: 11.8 litres (2.6 Imp gal)
Range: about 22.8 m (25 yards)
Duration of fire: 20 seconds

Below: The L3 Lanciafiamme was the most widely used of the Italian flamethrower tanks. The fuel was carried in a trailer weighing 500 kg (1,102 lb), but some later models used a much smaller fuel tank mounted over the rear hull.





The Italian L3 Lanciafiamme carried its fuel in a trailer connected to the flame gun by a flexible hose. The propellant gas was contained in a cylinder on the rear of the chassis, but later versions carried both fuel and gas actually on the hull exterior. The L3 Lanciafiamme was the most widely used of the Italian mobile flamethrowers.

Nicaragua

In 1979 Nicaragua fell to the Sandinista National Liberation Front after about a year of bloody civil war. Since then the army has been built up with Cuban and Soviet help to become the largest in Central America; Nicaragua has thus come to be regarded by the US administration as the primary threat to stability in the region. The Americans therefore support a number of guerrilla forces whose aim is to overthrow the Sandinistas, and who are collectively called the 'Contras'. These guerrilla bands operate across the borders from both Honduras and Costa Rica.

The Nicaraguan army numbers more than 60,000 and comprises the following units:

one motorized infantry battalion,
three armoured battalions,
12 infantry battalions,
three light infantry battalions,
one engineer battalion,
one air-defence regiment (under air force control) and
two field artillery regiments (with three battalions each).

Weapons come from a number of countries, but the major source is now the Eastern bloc, with delivery usually via Cuba. There are around 3,000 Cuban and 100 Soviet advisers in the country at any one time. Listed below are the army's primary types and numbers of equipment.

armour: 110 T-54 and T-55 MBTs and PT-76 light amphibious tanks; 20 BRDM-2 and 20 T17 Staghound armoured cars; 100 plus BTR-40, BTR-60 and BTR-152 APCs
artillery: US M1/M29 81-mm (3.19-in), Soviet M1937/1941/1943 82-mm (3.23-in), Soviet M1938/1943 120-mm (4.72-in) and Israeli Soltam 120-mm mortars; 12 US 105-mm (4.13-in) M101 howitzers; 24 M1938 122-mm (4.8-in), 12 D-30 122-mm, 12 D-20 152-mm (6-in) Soviet howitzers; 30 M1942 76-mm (3-in) Soviet field guns; 12 BM-21 Soviet multiple rocket-launchers
anti-armour weapons: 57-mm (2.24-in) M18, 73-mm (2.87-in) SPG-9 and 106-mm (4.17-in) M40A1 recoilless rifles; Soviet RPG-7 and French 68-mm (2.68-in) SARPAC rocket-launchers
anti-aircraft weapons: SA-7 'Grail' SAMs, SA-8 'Gecko' SAMs, SA-9 'Gaskin' SAMs; 14.5-mm (0.57-in) ZPU-1/2/4 guns, 23-mm ZU-23 guns, 37-mm M1939 guns, 40-mm M1 guns and 57-mm S-60 guns
small arms: American M16A1, Israeli Galil, Soviet AK-47 and AKM assault rifles; Israeli Uzi sub-machine guns; American M60, Soviet RPD, RPK and RP-46 light machine-guns; 7.62-mm Browning medium machine-guns; Soviet DShK 12.7-mm (0.5-in) and Browning 12.7-mm heavy machine-guns.

The navy is a small coastal defence force of some 300 men with 15 patrol craft and a single LCM. Of the patrol boats the most important are the four Israeli 'Dabut' class craft armed with 20-mm cannon and heavy machine-guns.

The air force is limited in size to 1,500 men or so, with no possibility at present of acquiring high-performance MiG fighters because of the threat of American pre-emptive air strikes. The major offensive capability is limited to the recent acquisition of six Mil Mi-24 'Hind-D' gunship helicopters plus a similar number of dual-role Czech Aero L-39 jet trainers/light strike aircraft. These supplement a varied mixture of older Western aircraft which mostly predate the civil war. The air force's composition is as follows:

one fighter/ground-attack squadron with three Lockheed T-33As, three North American AT-28Ds, six SIAI-Marchetti SF.260 Warriors, six Aero L-39s, and six Mil Mi-24 'Hind-Ds'
one transport squadron with one CASA C-212, one IAI Arava, four Douglas C-47s, one Dassault-Breguet Falcon 20, and two or three Antonov An-2 'Colts'
one helicopter squadron with two Aérospatiale Alouette IIIs, two Hughes OH-6As, and two or three Mil Mi-8 'Hips'.

A soldier of the Nicaraguan army mans a checkpoint in the capital, Managua. Since overthrowing the US-backed Somoza regime in 1979 the Sandinistas have acquired many of the trappings of a regular army but remain essentially a guerrilla force with very limited offensive capacity.

To support these front-line elements there are 60,000 reservists together with 4,000 border guards and a civilian militia of 40,000. To maintain internal security in key areas there are also some 2,000 to 3,000 Ministry of the Interior troops. All of these second-line units are armed to varying standards and usually come into contact with 'Contra' units during the course of their duties.

12 Pass

El Salvador

***Above:* El Salvador's latest revolutionary war is now eight years old, and the army must patrol constantly to retain control of the countryside; jeep patrols like this are always vulnerable to landmines, even near the capital.**

El Salvador is the most densely populated of the countries in Central America, and since 1977 has suffered major internal subversion with the US-supported right-wing government fighting increasingly better-armed and better-trained left-wing guerrilla groups which receive support from the Soviet Union and Cuba. The country is divided into three zones (the Western, Central and Eastern Defence Zones) which cover the 14 individual departments or states. Military service is now compulsory for all male citizens between the ages of 18 and 60 in order to maintain the unit levels required by the three services.

The army has a manpower strength of more than 40,000 and comprises the following units:

three infantry brigades (each of two infantry regiments with one regular and two reserve battalions apiece)
one infantry brigade (with four specialist anti-guerrilla infantry battalions),
three independent special forces battalions,
one mechanized cavalry regiment,
one artillery regiment (with two battalions),
14 independent light infantry battalions (one per department),
nine reserve infantry regiments (with three battalions each),
one engineer battalion,
one paratroop battalion (under air force control) and
one air-defence battalion (under air force control).

The equipment used by these units comes from a number of sources including (surprisingly) Yugoslavia, and although sparse in some areas is relatively modern. The standard of training is improving slowly as the American influence increases, but the army still periodically suffers defeats at the hands of the rebels. Listed below are the army's primary types and numbers of equipment.

armour: 12 AMX-13 light tanks, 18 AML-90 armoured cars, 20 UR-416 APCs, 10 M113 APCs and an unknown number of locally modified M114 APCs
artillery: 81-mm (3.19-in) Hotchkiss-Brandt mortars and Yugoslav 120-mm (4.72-in) UBM-52 mortars; 12 Yugoslav M56 105-mm (4.13-in) howitzers, 30 105-mm M101 howitzers, and six M114 155-mm (6.1-in) howitzers
anti-armour weapons: 57-mm (2.24-in) M18 and 75-mm (2.95-in) M20 recoilless rifles; 66-mm (2.6-in) M72 and Israeli 80-mm (3.15-in) rocket-launchers
anti-aircraft weapons: 20-mm Breda, Yugoslav 20-mm M55 triple and 40-mm Bofors L/60 guns
small arms: M1 Garand and M14 rifles; Israeli Galil, US M16A2 and West German G-3 assault rifles; Israeli Uzi sub-machine guns; 7.62-mm (0.3-in) Madsen Model M1954 and 7.62-mm M60 light machine-guns; 7.62-mm Browning medium machine-guns; and 12.7-mm (0.5-in) Browning heavy machine-guns.

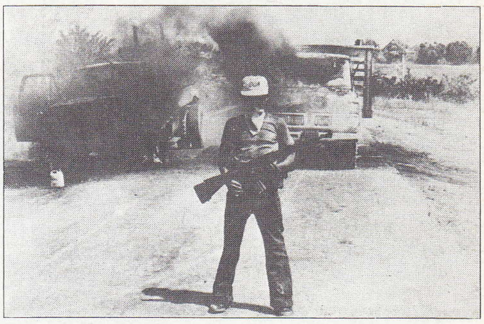
To back the army there is a small but potent air force of around 1,500 men. The air force flies both American and ex-Israeli warplanes which are tasked with both COIN and army close-support missions. One recent addition to the inventory has been a single Douglas AC-47 'Spooky' gunship conversion of the venerable Dakota. Although not armed with Miniguns, this has three single 12.7-mm heavy machine-guns and operates on exactly the same principles as the Vietnam War gunships in orbiting a target to bring it under fire. If the aircraft proves successful then a second will be procured. Otherwise air strikes are confined to rockets, general-purpose bombs with extended fuses, and cannon or machine-gun fire.

The air force comprises the following units:

Escuadrilla de Caza with 18 Dassault-Breguet Super Mystères;
Escuadrilla de Caza Bombarda with 11 Dassault-Breguet Ouragans;
Escuadrilla de Ataque with 17 Cessna A-37 Dragonflies, seven Aérospatiale C.M.170 Magisters and one Douglas AC-47 'Spooky';
Escuadrilla de Transporte with two Fairchild C-123Ks, two Douglas DC-6Bs, five IAI Aravas and five Douglas C-47s;
Escuela de Aviacion Militar with three C.M.170 Magisters, six Cessna T-41s, eight North American T-6 Texans, three Beech T-34 Mentors, seven Cessna 180s, one Cessna 182 and one Cessna 185; and
miscellaneous: six Cessna O-2As, three Aérospatiale SA 315B Lamas, two Aérospatiale Alouette IIIs, one Fairchild-Hiller FH-1100, 18 or more Bell UH-1Hs and one Hughes 500D.

Not all of the aircraft are airworthy at the same time, some being mothballed for spares and others undergoing maintenance or battle damage repairs.

The Salvadorean navy is based on the long Pacific coast, and is used for patrols against gun runners and for customs work. The navy has a strength of 130 men to man seven patrol boats and a small tug. The patrols are meant to restrict the influx of weapons and supplies that are channelled to the rebels via El Salvador's near neighbour Nicaragua.



A guerrilla poses by the site of a successful ambush on the coastal highway. Generations of oppressive government have created fertile ground for Soviet-backed revolution.

Government troops have improved in effectiveness, thanks to an influx of US aid: the machine-gunner carries an American M60 GPMG, his number two an M16A1 rifle.